

Air and space power and security in the 21st century

DR. JEAN-JACQUES PATRY *Research fellow, Fondation pour la Recherche Stratégique*

PHILIPPE GROS *Research fellow, Fondation pour la Recherche Stratégique*

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Acronyms

ATO	: Air Tasking Order
BMC3I	: Battle Management Command, Control, Communication and Intelligence
C ²	: Command and Control
CAOC	: Combined Air Operations Center
CAP	: Combat Air Patrol
CAS	: Close Air Support
CCD	: Concealment, Camouflage, Deception
CENTCOM	: Central Command (US)
CEP	: Circular Error Probable
COMINT	: Communications Intelligence
CSAR	: Combat Search and Rescue
DDR	: Disarmament, Demobilization, Reintegration
DoD	: Department of Defense
EBO	: Effects-Based Operations
ELINT	: Electronic Intelligence
FARC	: <i>Fuerzas armadas revolucionarias de Colombia</i>
GPS	: Global Positioning System
GWOT	: Global War on Terror
HALE	: High Altitude Long Endurance
HPT	: High Pay-Off Target
HVT	: High Value Target
IADS	: Integrated Air Defense System
IMINT	: Imagery Intelligence
IO	: Information Operations
ISR	: Intelligence Surveillance & Reconnaissance
IW	: Irregular Warfare
JDAM	: Joint Direct Attack Munition
JFACC	: Joint Force Air Component Command
JFCOM	: Joint Forces Command (US)
JSOW	: Joint Stand-Off Weapon

JTAC	: Joint Terminal Attack Controller
MALE	: Medium Altitude Long Endurance
MDA	: Maritime Domain Awareness
MASINT	: Measurement and Signature Intelligence
NATO	: North Atlantic Treaty Organization
NCW	: Network-Centric Warfare
NM	: Nautical Mile
OAF	: Operation Allied Force
ODS :	: Operation Desert Storm
OEF :	: Operation Enduring Freedom
OIF	: Operation Iraqi Freedom
PGM	: Precision Guided Munition
PSYOP	: Psychological Operations
RAF	: Royal Air Force
SAM	: Surface to Air Missile
SATCOM	: Satellite Communications
SEAD	: Suppression of Enemy Air Defenses
SFE	: Space Force Enhancement
SHORAD	: Short-Range Air Defense
SIGINT	: Signal Intelligence
SSTR	: Support to Stabilization, Transition, and Reconstruction
STRATCOM	: Strategic Command (US)
TCT	: Time-Critical Targeting
TELINT	: Telemetric Intelligence
TST	: Time-Sensitive Targeting
UAV	: Unmanned Air Vehicle
UCAV	: Unmanned Combat Air Vehicle
UK	: United Kingdom
USA	: United States of America
USAF	: United States Air Force
USMC	: United States Marine Corps

Introduction: Purposes and Methodological Approach of the Study

1.1.1 – Rising Interest of Air and Space Power in Expanding Domains of International Security

Air and space power is gaining a critical importance in almost every dimension of the 21st Century international security. This trend can be explained by the following reasons:

Firstly, air and space power does not belong only to airmen, when compared to the most traditional conception of the 20th Century airpower operated by newly independent air force services. For a few decades, maritime and ground forces have been taking an active part in the mastering of the third dimension. Special Forces also depend heavily on airlift assets for support and space capabilities for communication and intelligence. This is why the authors retain the U.S. definition of air and space power: *“The ability to use platform operating in or passing through the air and space medium for military purpose”*¹.

In the meantime, international security policies have constantly evolved under the pressure of new stakeholders; international organizations, non-governmental organizations, public opinion through mass media and new information technology. Many air and space capabilities (Imagery intelligence – IMINT, Signal intelligence SIGINT...) have a dual purpose and could be operated by national and international institutions dedicated to security; coast-guards, customs, constabulary forces, home defense organizations and units. Therefore, the aforementioned definition of air and space power should be amended as followed: *“The ability to use platform operating in or passing through the air and space medium for military and security purposes”*.

1.1.2 – Consequently, Military Capabilities, Including Aerospace Power Have to Address Objectives of New Security Policies

The authors define security policies as: *“a set of measures aiming first at assuring the safety of an entity, and second providing it with a psychological feeling of invulnerability when facing a given risk, danger or threat”*. Therefore a security policy, whatever the objective, is made of a combination of measures for the prevention of a risk or a threat; for the protection against their likely effects, and for assuring the recovery after suffering damages or losses.

In the realm of the international relations of the 20th Century, security policies were mostly oriented on the preservation of state sovereignty and territorial integrity in an anarchical world. Military might backed by powerful state bureaucracies and defense diplomacy were supposed to provide adequate means to protect population and national territories against conventional aggression. The concept of airpower is born in this *“Hobbesian”* environment, soon revealing all the strategic effects it could bring to bear when attacking the vital centers of gravity of entire nations. Then the development of

¹ AFM 1-1, *Basic Aerospace Doctrine of the USA*, 17 November 2003, vol. 1, p. 11.

Cold-war nuclear arsenals not only confirmed but increased the critical dimension of airpower in modern warfare; a critical dimension still valid today.

In the meantime, other security policies aiming at promoting economic cooperation among nations have been elaborated to meet new needs of post-industrial societies. International commerce and trade were deemed to be the best guarantees for peace and stability by increasing mutual benefits. A network of multi-national institutions settled a framework for economic policy common to state and non-state entities (firms, banking system...). However, "economic security" remained a major issue to preserve free access to sources of raw materials and energy (oil) for developed countries. To this regard, surveillance and protection of worldwide air and sea lines of communication became a traditional mission of aero-maritime forces (carrier strike groups - CSG) or airpower. Indeed "big nations" used to constantly neat a network of air / naval bases in the vicinity of sensitive areas (Middle-East, Africa...), thus backing joint expeditionary forces committed in contingency missions.

A security policy of a third kind was engaged by the very end of the 20st Century. Called "cooperative security" the purpose was to facilitate the negotiations and implementations the disarmament treaties in the Northern Hemisphere: *Intermediate-Range Nuclear Forces* (1987), *Conventional Armed Forces in Europe* (1990) and the *Strategic Arms Reduction Treaties* between the USA and the Former-Soviet Union / Russia. The tenants of "cooperative security" posit that confidence is the ultimate condition for security. Therefore, governments have to include the vital interests of their partners into their own policy-making calculus. In addition, a set of verifiable measures of control (*Confidence and Security-Building Measures*) should establish a regime of transparency and then ease the relations between parties. Critical assets are provided by joint military expertise, with in-situ inspections and "open skies" missions. Therefore, even in a cooperative security environment airpower remains a helpful instrument.

Finally, ecology issues have also become goals for new "environmental security policies". This happened slowly in the three past decades under the constant pressure of the media and the public opinion despaired about the detrimental effects of environmental disasters (*Exxon Valdez* in Northern American, *Amoco Cadiz*, *Prestige*, *Erika* in Europe, Seveso in Italy and Bhopal incident in India...). The idea that the future of mankind could be endangered by the negative side-effects of economic development is now well established. An abundant academic literature highlights the relations between climate changes, human migrations and armed conflicts for scarce resources². So far, the international instruments to address these challenges are still in their infancy. Nevertheless they develop steadily under the influence of environmental lobbyist groups and the media putting pressure on governments. However, military forces are affected by this new dimension of international security: They are tasked to provide capabilities for emergency situation and relief assistance, chemical or biological decontamination in polluted areas, and for monitoring maritime areas. The information provided by observation satellites play a crucial role in the anticipation and management of climatic and environmental crises with humanitarian consequences.

² Peter Schwartz and Doug Randall, *An Abrupt Climate Change Scenario and its Implications for the United States National Security*, US DoD, October 2003, 22 p. See also: Renate Schubert and ali., *Climate Change as a Security Risk*, Earthscan, German Advisory Council on Global Change, 2007, 271 p.

This brief *tour d'horizon* highlights the relationship between the air and space instrument as a whole and the various fields of international security in which it can be practically used.

1.1.3 – Purpose of this Study: Defining a Catalog of Aerospace Power Postures

Contemporary air and space power is a highly integrated instrument, capable of producing different effects on wide geographic areas. Including the ocean space, all parts of the world are virtually within its reach. Granted with characteristics of precision, swiftness and persistence air and space power provides also a quasi-ubiquity capacity to those who use its capabilities and a whole set of simultaneous kinetic and non-kinetic effects all over a theater of operations.

However, air and space power shows recognizable postures, depending mostly on missions to fulfill, features of targeted enemies, and effects to produce in the field. These postures encompass a set of capabilities and know-how tailored to match distinct style of warfare, conventional or unconventional. This is precisely the purpose of this paper to:

- Make an assessment of the air and space power features in all type of engagement;
- Highlight the best air and space postures in each form of warfare and regarding each type of security commitment.

In a way an academic approach based on air and space postures unveils how governments, armed forces - both national and multinational - and international organizations in charge of collective security can adapt air and space capabilities to match closely operational challenges.

1.1.4 – Aerospace Postures Reveal Tailored Capabilities Responding to Specific Operational Requirements

A few comments on “air and space posture” are necessary to catch the bottom line of this paper. A national air and space power is the final product of a long and costly force generation process driven by complementary rationales.

A **strategic rationale** shaped by the constraints of the international environment met by a state promoting an “offensive” or “defensive” political end state, the nature of faced threats and the level of available resources. Aerospace power, like ground or naval powers, should normally be a part of a comprehensive strategy (national security strategy or grand strategy) and of subordinate joint military and operational strategies.

The rationale of a **national strategic culture** expresses favored tendencies in the use of force and preferred instrument of military power in conflict situations. Aerospace power could then be conceived either as a critical asset with strategic effects, or be considered only as an auxiliary tool backing maritime or land power.

Finally, the **military organizational culture** of institutions in charge of operating air and space power capabilities plays a critical role in the framing of an air and space posture. Air / Navy forces as well as army aviation have developed long term preferences in terms of integrating technologies into an innovation process. Some institutions – USAF, *Royal Air Force (RAF)*, *Israeli Air Force* – develop a somewhat innovative vision of air and space power and are able to create an influential model while others may generate just enough capabilities from the scrap to tackle with a

tactical problem at hand. Despite significant differences in size, prestige, allocation of resources, all these institutions have in common to build up appropriate postures to fulfill their missions.

Even though an official definition does not exist in the French military terminology, we mean by **posture**: “A consistent combination of strategic / operational concept of force engagement and related capabilities congruent to the achievement of a security policy goal”.

Military postures serve as a joint framework for campaigning and conducting operations. In military history, two dominant postures constantly appear as trends: offensive and defensive. Except for some superpowers such as the U.S.A. (or the former Soviet Union in the past decades), few states can actually build up and operate simultaneously these postures. Actually, most of them have no other choice left than to select one option and stick to it. Aerospace power capabilities are therefore tailored to meet the requirements of these distinct joint postures.

1.1.5 – A Method of Analysis Based on Comparative Case Studies

Forms of employment of air and space postures will be explored in two strategic modes:

- ➔ A direct “*confrontational strategic mode*” encompassing conventional and irregular forms of warfare;
- ➔ A “*cooperative strategic mode*” including all non-military forms of air and space intervention dealing with risk prevention, non-violent crisis management or humanitarian assistance.

Aerospace postures will be analyzed through a comparative study of campaigns and operations in each strategic mode to identify proper key capabilities.

In conclusion, recommendations and indications will be issued on the best way to use the results of the study for practical purposes in the domain of assessment of user’s need of air and space postures.

Finally, considering the critical importance of the technical and doctrinal air and space vocabulary, the research team has retained the taxonomy of air and space operational functions and effects adopted by the *Joint Fires and Targeting Handbook* developed by U.S. Joint Force Command.

PART I – AIR AND SPACE POWER IN INTERNATIONAL SECURITY ENVIRONMENT

In the 20th Century, airpower was mostly used in conventional defense missions. Increasing its efficiency in “**confrontational strategies**” was a permanent concern of the air services through a constant technological cycle of innovation. A great deal of effort was also devoted to the improvement of doctrines of air operations. Decade after decade, airpower truly became a highly versatile and lethal military instrument. Even though engaged in many civil wars and post-colonial insurgencies, airpower focused on conventional warfare and was less influenced by irregular forms of operations.

By contrast, the current and predictable international environment for the next three decades offers quite different perspectives. The effects of world globalization have created new emerging powers in the realm of economic and political competition. The Western status quo of the international order inherited from the end of the Cold-war is now questioned by mighty newcomers (China, India or Russia). In the meantime, new non-state entities emerged as sources of asymmetrical threats to the international security. Most of these organizations (terrorist, guerrilla, organized crime...) flourished in fragile or even failed states. Consequently, confrontational strategies will probably not vanish away in the future, but instead develop into non-conventional forms of armed conflicts.

In addition, new “cooperative strategies” appear to become a major concern for the international community in terms of operations of humanitarian assistance, prevention of mass casualties (environmental disasters) or reconstruction in post-chaotic environment. These multinational strategies, still in their infancy at the moment, have in common to serve new dimensions of the human societies’ security. Compared to the “confrontational strategies”, success relies heavily on trust and confidence between partners and less on the control of geographical *milieu* or areas by force.

Aerospace power is most concerned by these trends, as the first reactive military instrument at the disposal of governments for early intervention or contingencies. Therefore, evolution of air and space operational functions is influenced by:

- ➔ The features of threats and risks to international security;
- ➔ The design of the strategies prepared to deal with them;
- ➔ The technological innovation;
- ➔ And finally by the conceptual and doctrinal evolutions of the US air and space power which in turn offers a prevailing model for allies and partners.

1 – The Aerospace Power Challenge; Maintaining a High Efficiency in all Forms of Operational Engagements

In the realm of confrontational strategies, operational performance of air and space power gained in conventional engagements all along the 20th Century is now challenged by asymmetrical organizations specifically designed to elude the effects of air dominance. In most non-military interventions, air and space assets are committed piecemeal without a clear vision of what should be the role of air and space power in cooperative strategy.

Therefore, the bottom line is: How restoring an acceptable operational efficiency whatever are the engagements? What kind of evolution to undertake in the domains of operational functions, organizations, equipment and doctrines?

1.1 – An International Dilemma

Many papers on prospective and security depict a somewhat similar view on the future challenges to the status quo of international order. To say the truth, the American strategic visions exposed in the *National Defense Strategy*³ and other official documents exert a seminal influence on the Western strategic literature⁴. The portrayed threats include usually “problem states” (previously known as rogue states – unfriendly governments), proliferation of weapons of mass destruction, terrorism, organized crime and cyber-crime activities.

A broad survey of the non-official literature produced after 9/11 in the domains of security and strategy indicate three big challenges to the system of international order:

- ➔ **Terrorism of mass casualties** - also described as “hyper-terrorism”⁵ – with a deep analysis on courses of actions and motivation linked to radical Islamism⁶;
- ➔ **Asymmetrical conflicts**⁷ - or fourth-generation warfare⁸ - used by non-state entities to elude the lethal effects of conventional military power. In this armed conflicts a right combination of a non-conventional courses of action with an indirect strategy

³ *National Defense Strategy*, June 2008, 23 p, pp. 2-5.

⁴ *A Secure Europe in a Better World*.; *European Security Strategy*, Brussels, 12 December 2003, pp. 3-4. See also the French White paper: *Défense et Sécurité nationale : Le Livre blanc*, Paris, Odile Jacob, 2008, Tome 1, Première partie, pp19-42.

⁵ François Heisbourg, *Hyperterrorisme : la nouvelle guerre*, Paris, Odile Jacob, 2002.

⁶ Bernard Lewis, *What Went Wrong, Western Impacts and Middle Eastern Response*, NY, Oxford University Press, 2002, 172 p.

⁷ Rod Thoron, *Asymmetric Warfare, Threats and Response in the Twenty-first Century*, Polity Press, 2007, 241 p.

⁸ Colonel Thomas X. Hammes, *The Sling and The Stone, On War in the 21st Century*, Zenith Press, 2004, 321 p.

should contribute to hit the moral of regular armed forces and cripple the political resistance of incumbent governments⁹;

- ➔ **Insurgency theories and counterinsurgency strategies** inherited from the post-colonial experience of the 50's and 60's inspiring nowadays military practice in Iraq and Afghanistan¹⁰.

A first synthesis drawn from these papers offers a grim vision of a 21st Century world arena divided in two distinct kind of geographic areas: An “integrated” world organized by public and private institutions both national and international, neighboring anarchical zones in which political systems are collapsing in “Hobbesien” social environments.

1.1.1 – Establishing an International Order within a New Hierarchy of Powers

The current world order is shaped by a class of continent-states (USA, Russia, China, India, Brazil) with all tangible and intangible elements of international power, capable of designing global security strategies in all critical dimensions economic, political, cultural, environmental and military. Through economic and political partnership, they all have in common to influence neighboring medium states: The USA in the European and Pacific areas, Russia and the CIS, China in the Pacific and Indian Ocean... Even Africa is divided in continental zones of influence under the scrutiny of regional powers such as Nigeria or South Africa.

In addition, a new influential class of states is emerging as a source of power distortion. As Micheal T. Klare has pointed out in a recent seminal study¹¹: “*In the planet's new energy order, countries can be divided into energy-surplus and energy-deficit nations (...). In the new order, a nation's rank will increasingly be determined by the vastness of its oil and gas reserves, or its ability to mobilize other sources of wealth in order to purchase the resources of the energy rich countries*”.

A fact for the purpose of this study is that the most powerful air / maritime and space powers in the Century will likely belong to these nations, with a purpose of competing or balancing the nowadays US and Western air and space supremacy.

1.1.2 – And Containing Forces of World Disintegration

However, security issues of the twenty-first century are not limited to the organization of regional areas of influence between state competitors. By opposition to the former strategic era many forces of disintegration are at work, both human and environmental.

As commonly depicted in the World Bank documents, the side-effects of globalization on fragile states will probably increase local instability. Paul Collier in a brilliant theory

⁹ Ivan Arreguin-Toft, *How the Weak Win Wars : A Theory of Asymmetric Conflict*, Cambridge University Press, 2005, 250 p.

¹⁰ The U.S. forces have included in the 2006 FM-3.24 *Counterinsurgency* the lessons learned in French Algeria through two main contributions: Roger Trinquier, *La guerre moderne*, Paris, La Table ronde, 1961, 200 p. and David Galula, *Counterinsurgency Warfare, Theory and Practice*, London and Dunmow, Pall Mall Press, 1964, 143 p.

¹¹ Michael T. Klare, *Rising Powers, Shrinking Planet – The New Geopolitics of Energy*, Metropolitan Books, New York, 2008, 339 p., p. 14.

on the dynamics of civil wars¹² posits that the competition for scarce resources generates or fosters social strife and internal armed conflicts in non-developed countries. Impotent authorities do not have any means to control national territories and to oppose effectively movements of armed rebellion. In failed states, a central government does not even exist (Somalia, Afghanistan). Insurgencies, as a usual form of internal conflict will probably be a major concern for incumbent governments and regular forces.

Another cause of growing fragility of contemporary societies lies in the erratic evolution of the climate. For about fifteen years, a consensus arose among scientists to consider environmental catastrophes as a major threat to human security and more recently to national security¹³. Even though natural catastrophes are common phenomena, they have destabilizing effects on shaky societies and fragile states. As a result, the international community is looking for new permanent instruments of humanitarian assistance. Maritime and Airlift capabilities are often called upon as enablers for interagency, multinational rescue task forces.

An increasing focus of air and space power on non-conventional forms of warfare and non-military missions should be expected and confirmed in the next decades.

1.2 – Facing Smart Asymmetrical Systems

Nurtured by Globalization Opportunities and World Deregulation

States are no longer the only actors capable of developing international policies or security strategies. A whole set of non-state organizations empowered by financial and technological resources now available in a global world can develop their own agenda through comprehensive strategies, including paramilitary forces and terrorism. They are often labeled as *asymmetrical entities*.

An abundant literature describes different types of violent organizations. John MacKinlay of the British *International Institute for Strategic Studies* explains how global changes on communication, transportation and deregulation have altered the nature of insurgency by weakening some governments and empowering the forces that seek to overthrow them. The book identifies four distinct categories of insurgent force, and concludes that globalization of insurgency leads inexorably to the globalization of counter-insurgency¹⁴. Dr. Phil Williams, an American specialist in criminal organizations observes that security in the 21st century has little to do with traditional power politics, military conflict between states, and issues of grand strategy. Instead he proposes a rejection of “state centric” assumptions and embraces the notion of the New Middle Ages characterized, among other things, by competing structures, fragmented authority, and the rise of “no-go” zones¹⁵.

¹² Paul Collier, Anke Hoeffler, *Greed and Grievance in Civil Wars*, CSAE WPS/2002-01, World Bank, 13 March 2002, 43 p.

¹³ Peter Schwartz, Doug Randall, op. cit. in footnote 2.

¹⁴ John MacKinlay, *Globalisation and Insurgency*, Adelphi Papers n° 352, IISS, London, 2002, 116 p.

¹⁵ Dr. Phil Williams, *From the New Middle Ages to a New Dark Age: The Decline of State and the U.S. Strategy*, U.S. War College, June 3, 2008, Carlisle (PA), 67 p.

1.2.1 – Shaped for Optimizing One or Several Forms of Collective Violence in Support of Their Goals

The FRS research team made also a similar survey few years ago and proposed a taxonomy of “*Asymmetrical Systems*” defined as: “*Potentially violent entities organized along a non-bureaucratic framework and even though able to plan and implement a comprehensive strategy combining non-military and military capabilities to gain a specific goal or sustain a general purpose of nuisance*”¹⁶. The study was at that time based on a comparative assessment of twenty five organizations practicing a distinct form of collective violence (guerilla warfare, terrorism, technical criminal violence) in terms of purpose, courses of actions, and functional systems of raising resources, mobilizing people, armament production and procurement.

The matrix shown below gives a synthesis of the notional entities and the way they organize themselves for optimizing a form of collective violence. Three parameters define notional models of violent organizations

The Concept of Asymmetrical Systems			
The Asymmetrical System: “ <i>Potentially violent entities organized along a non-bureaucratic framework and even though able to plan and implement a comprehensive strategy combining non-military and military capabilities to gain a specific goal or sustain a general purpose of nuisance</i> ”.			
	ASYMMETRICAL SYSTEMS		
Type of Goal	Power Claiming	Subversive	Spoiler
Type of organization	Counter-state organization	Secret Cell Organization	Business like Organization
Type of collective violence	Paramilitary Violence	Activist group Violence	Organized crime Violence
	Riot violence		

Source: FRS-CEROM

- ➔ The goal sought by the entity; **subversion** (Communist terrorist cells in the 70’s in Italy or Germany – al qu’Aïda first generation); **claiming local power** (Irish Republican Army, LTTE in Sri Lanka...; Or **spoilers** only motivated by illegal profits and criminal activities;
- ➔ The operational functions shaping the entity; Decision making architecture, command and control, mobilization of people, resources collection, internal security, intelligence, procurement. Three models of organizations are identified:

¹⁶ Dr. Jean-Jacques Patry, *Forces terrestres en opérations, Quels modes d’action adopter face à des adversaires asymétriques ?*, Cahiers de la recherche doctrinale, CDEF/DREX, octobre 2004, 88 p. http://www.cdef.terre.defense.gouv.fr/publications/cahiers_drex/les_cahiers_recherche.htm.

- ⇒ The counter-state¹⁷;
- ⇒ The secret cell¹⁸;
- ⇒ The business-like organization.
- ➔ The favorite form of collective violence (paramilitary, group of activists, rioters, civil disobedience) based on a set of courses of action relevant to the sought goal and the level of resources, manpower and armament.

The asymmetrical systems are living entities evolving under the pressure of the environment, opposition to their goals, constraints or obstacles impeding their favorite practice of violence. An organization in the real world would have probably to mature and evolve from a simple architecture to a complex and sophisticated framework to prevail in a violent competition. Air and space power will have to adapt to these new adversaries.

1.3 – GWOT: A General Framework for Air and Space Engagements

The *War on Terrorism* - or *Global War on Terror (GWOT)* - is the common term specifically used under the auspices of President Bush Administrations in reference to operations led by the United States, since the September 11, 2001 attacks. The stated objectives of the war are to protect US citizens and interests in the US and abroad, break up terrorist cells in the US, and disrupt the activities of the international network of terrorist organizations. The term GWOT is no more used by President Obama Administration, but nevertheless, the core of the strategy is still valid.

1.3.1 – A Comprehensive Strategy for Combating Terrorism

The National Strategy for Combating Terrorism issued in 2003 and renewed in 2006 sets forth a comprehensive framework for waging the US and Allies war activities. The overarching strategic purposes of the US security policy are providing a framework guiding civilian and military activities¹⁹:

- ➔ Advance effective democracies as the long-term antidote to the ideology of terrorism;
- ➔ Prevent attacks by terrorist networks;
- ➔ Deny terrorists the support and sanctuary of rogue states;
- ➔ Deny terrorists control of any nation they would use as a base and launching pad for terror; and

¹⁷ A Counter-State organization “*Practices a form of armed rebellion against a national or international level, based on the mobilization of a population. It has a functional structure divided by geographical level, able to provide a framework to local population and a command for planning and conducting the armed struggle from a territory under control*”. Jean-Jacques Patry, *L’ombre déchirée : la puissance aérienne contre la terre*, L’Harmattan, Paris, 2007, 127 p., p. 34.

¹⁸ A Secret-Cell organization “*Practices a form of armed rebellion against a national or international level, based on action of isolated individuals or groups of violent activists. It has a functional structure of clandestine cells isolating members of the environment and preserving the confidentiality necessary to their freedom of movement and action*”. Ibid. p. 33.

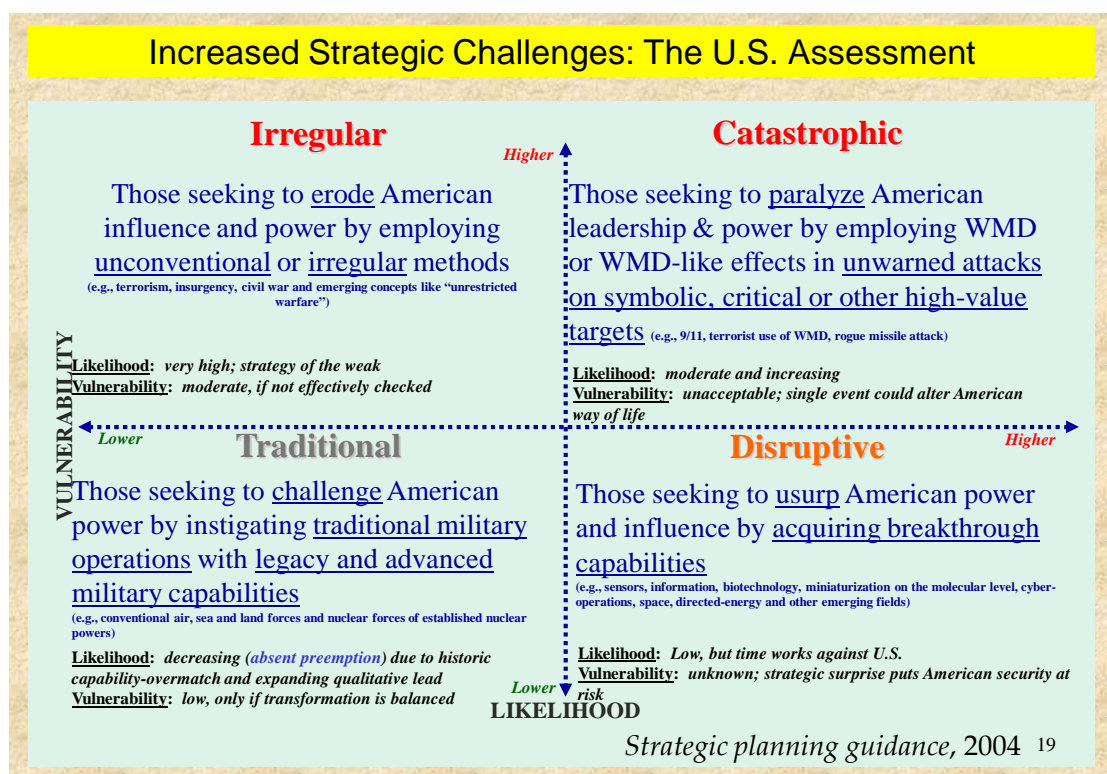
¹⁹ *The National Strategy for Combating Terrorism*, The White House, September 2006, Washington DC, 29 p., p.1.

- ➔ Lay the foundations and build the institutions and structures we need to carry the fight forward against terror and help ensure our ultimate success.

Consequently all components of air and space power are involved in this comprehensive strategy through a wide scope of new missions.

1.3.2 – *The Four Challenges and the Way to Hybrid Warfare*

The commitment of the US armed forces and allies in GWOT engagements, especially in Afghanistan and Iraq led to a full conceptual and doctrinal adaptation to new missions and adversaries. In the 2004 *Defense Planning Guidance* the four challenges to the US security had been portrayed as following Pentagon “*Quad Charts*”:



Compared to the other challenges which have no official definition in US terminology, *Irregular Warfare* (IW) has recently focused the attention of most of the defense and security establishment. IW is defined : “as a violent struggle among state and non-state actors for legitimacy and influence over the relevant populations. IW favors indirect and asymmetric approaches, though it may employ the full range of military and other capabilities, in order to erode an adversary’s power, influence, and will”²⁰.

Combinations of all the challenges led to the concept of *Hybrid Warfare* (HW), captured by the scholar Frank Hoffman: “*Hybrid Wars incorporate a range of different*

²⁰ *Irregular Warfare*, Joint Operating Concept, version 1.0, 11 September 2007, p. 6.

modes of warfare, including conventional capabilities, irregular tactics and formations, terrorist acts including indiscriminate violence and coercion, and criminal disorder”²¹.

The US “new challenges” reached the partners through many programs of military assistance and interoperability and thus became part of the strategic agenda of the allied armed forces, including air and space power.

2 – Current Paradigms for the Air and Space Power

Relying mainly on the US theories and operational practices, a set of paradigms has emerged for a couple of decades to shape the employment of air and space power.

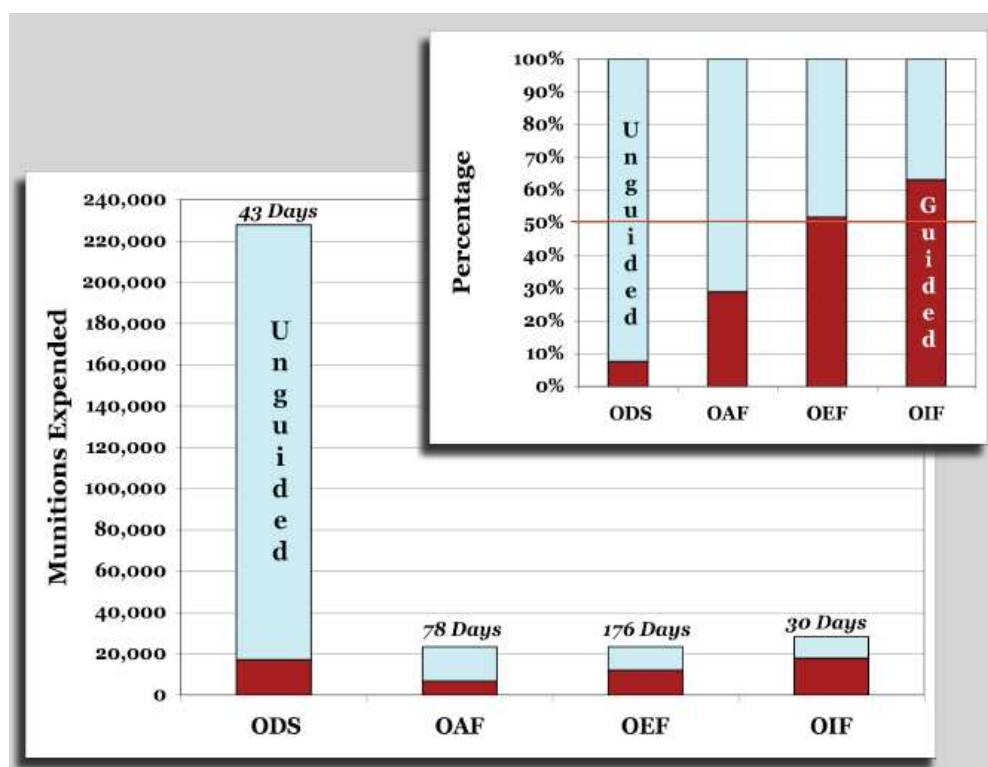
2.1 – Precision

The first paradigm is technical. Precision strike became a norm for offensive air and space power. The first important use of precision guided munitions (PGM) took place during the Vietnam War when Air Force and Navy aircrafts released nearly 20,000 Laser-Guided Bombs (LGB) Electro-Optic-Guided Missiles (such as AGM-62 Walleye).

Nevertheless, it was not before the first Gulf War that these precision capabilities have been integrated within the concept of air and space power, which has been considered as a major contributor to the coalition victory against Saddam Hussein.

From 1990’s, precision strike became the norm for air-ground operations thanks to two main technical and programmatic evolutions. The first one has been to augment significantly the potential firepower by extending the use of PGM. *Air Force* and *Navy* started to make almost all of their aircrafts (not only F-15E and F-117, but also F-16, F-18, AV-8B, B-52, B-1B, B-2 bombers, even the carrier-based interceptor F-14) able to release precision munitions. Thousands of targeting pods such as LANTIRN, LITENING, and SNIPER were bought. Only the F-15C Eagle remains dedicated exclusively to air superiority. With some delays, allied forces followed the same trend.

²¹ Franck G. Hoffman, *Conflict in the 21st Century : The Rise of Hybrid Wars*, Potomac Institute for Policy Studies, Arlington (VA), December 2007, 72 p., p. 14.



Source : Barry Watts, *Six Decades of Guided Munitions, Progress and Prospect*, Center for Strategic and Budgetary Assessment, mars 2007, p. 20

The second evolution was the introduction of the *Global Positioning System* (GPS)-guidance. It offers significant advantages over previous guidance modes. Indeed, LGB are precise but not all-weather and require a designation by the launch platform or a ground operator. EO/IR-guided missiles are almost as precise as LGB, more autonomous but not very cheap.

GPS guidance was initially inferior to those two modes but is constantly upgraded. The Circular Error Probable, which was around 13 meters at the beginning of the 1990's, went down below 4 meters during Iraqi Freedom. It's far from the metric CEP of LGB *Paveway III* but enhance by twofold the precision of the LGB *Paveway I et II*.

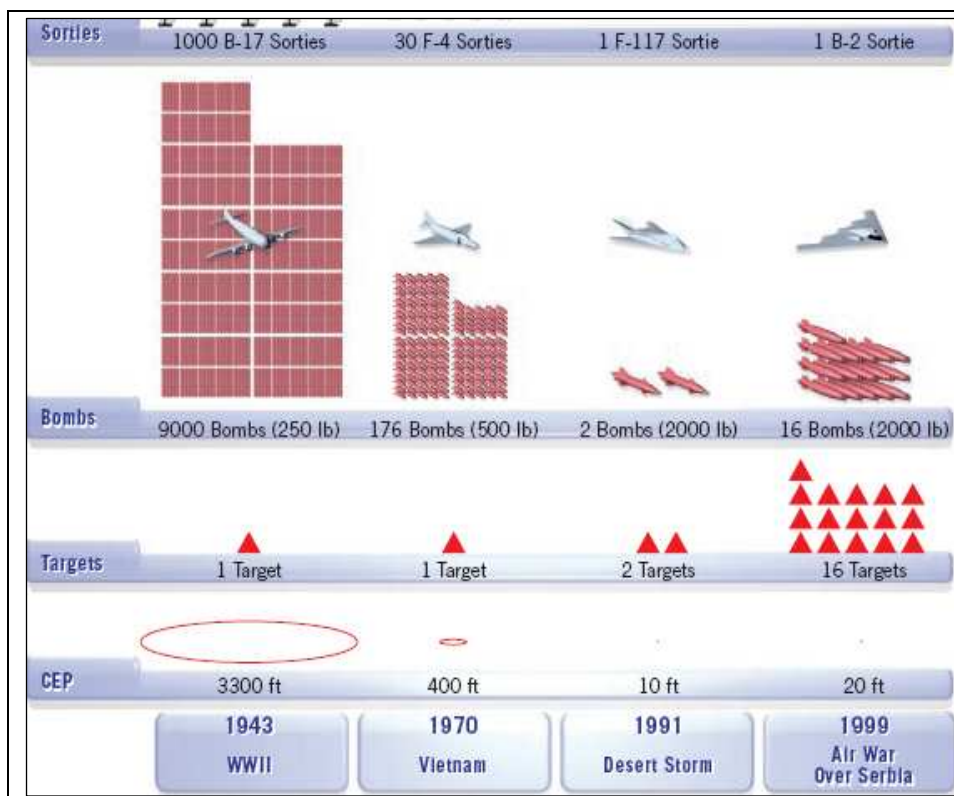
GPS guidance offers three other advantages: it is all-weather, autonomous (the aircraft release the munitions on coordinates) and cheap. The cost of one GPS-guided *Joint Direct Attack Munition* (JDAM) is around 33,000 \$, more than the older LGB *Paveway I* one (24,000 \$) but far less than the *Paveway III*, which amount to 100,000 \$ a piece²². The Navy modified its *Tomahawk* cruise missiles, from *Block II* and later versions, to operate with GPS instead of the complicated TERCOM digital navigation system and terminal imaging correlation guidance.

As logic conclusion, the percentage of PGM grew significantly over the last four campaigns and is over 50% after OEF. A campaign relying exclusively on guided munitions is no longer outside the scope. Besides, the half of all the precision munitions released during OEF and OIF were JDAM and *Joint Stand-Off Weapons* (JSOW).

²² Barry D. Watts, *Six Decades of Guided Munitions and Battle Networks, Progress and Prospect*, Center for Strategic and Budgetary Assessment, mars 2007, p. 203, pp. 221-223.

2.2 – Parallel Warfare

Colonel Deptula, who participated to *Desert Storm* planning, popularized in 1995 two operational concepts for air power, fully exploiting advances in precision and stealth capabilities: parallel warfare and effects-based operations.



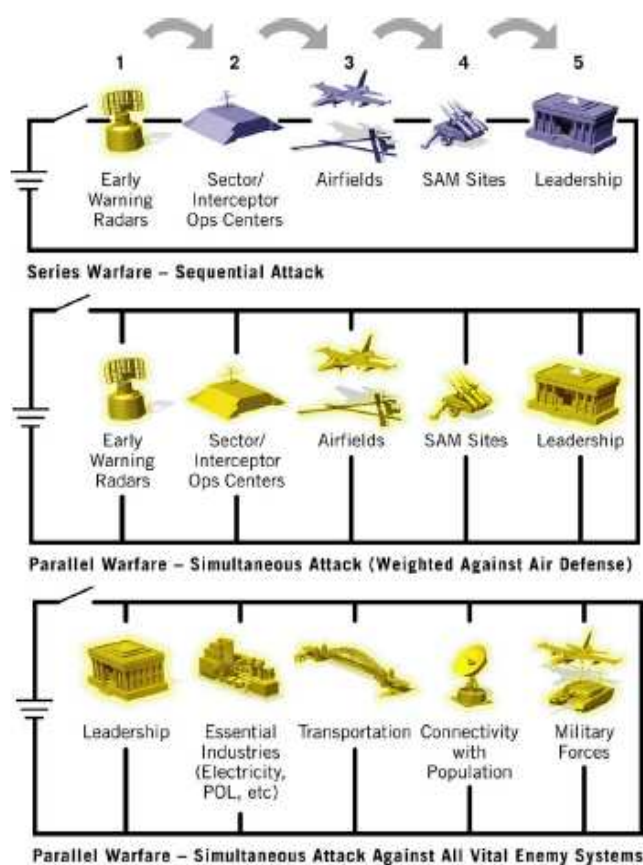
Source : Brigadier General David A. Deptula, *Effect-Based Operations : Change in the Nature of Warfare*, Defense and Air Power Series, Aerospace Education Foundation, 2001, p.8

Precision alters dramatically the strategic principle of Economy of forces in the domain of air warfare. During World War II, 9,000 bombs and 1,000 B-17 sorties were necessary to destroy one target. Now, one B2 bomber can strike 16 targets in only one sortie. As a result, the efficiency of airpower grows exponentially.

Colonel Deptula explained that this economy of force allows waging parallel operations and no longer sequential ones, to make an analogy with power circulation. Previously, airpower had to strike targets successively, for instance the radars, then command and reporting centers, then surface-air missiles systems. Now, one wave can strike concurrently many targets within one target set but more broadly many target systems of the campaign plan (i.e. air defense, leadership, economic resources, etc.).

Parallel warfare allows exploiting the ubiquity of the airpower which in turn provides a freedom of maneuver within the enemy strategic dimensions. Parallel warfare enables the destabilization of the enemy through multiple attacks on its vital systems, saturating

its reaction and adaptations ability, thus paralyzing its decision making process. Parallel warfare is intended to achieve *Rapid Dominance* over the enemy.



Source: Brigadier General David A. Deptula, *Effect-Based Operations : Change in the Nature of Warfare*, Defense and Air Power Series, Aerospace Education Foundation, 2001, p.4

2.3 – The Effects-Based Operations

The freedom of maneuver enabled by parallel warfare allows tailoring the air effort according to the effects to be achieved. Conversely, these Effects-Based Operations, (EBO) offer a methodology to define the best strategy to reach the Rapid Dominance.

Among key elements of the EBO, the adversary must be analyzed as a system, as pretend Colonel Warden, whom Deptula is a disciple. Colonel Warden was leading the *Checkmate*, a team of the Air Force Headquarters intended to change the doctrine of the service, when he was tasked to work on Desert Storm air campaign plan. Although he had very stormy relations with General Horner, CENTCOM JFACC, his plan, *Instant Thunder* became the nucleus of the strategic air campaign waged in January-February 1991²³. Warden developed his well-known five rings-model of the adversary²⁴. This

²³ Frederick W Kagan, *Finding the Target, The Transformation of American Military Policy*, NY, Encounter Books, 2006, 432 p.

²⁴ John A. Warden III, « The Enemy as a System », *Airpower Journal*, Spring 1995, pp. 40-55.

model can characterize each sub-systems of the adversary. Other models of the same kind have been developed in the 90's, such as the Jason Barlow's one, which suggest to analyze the "national elements of value" and to better take into account the ability of the adversary to adapt to the blows of air campaign. Other important part in EBO process is the assessment of the achievement of undertaken effects and action through matrix of *Measurement of Effectiveness* (MoEs) and *Measurement of Performance* (MoPs).

As a matter of fact, the will to depart from attrition warfare has always been a fundamental of the proponents of the airpower. Indeed, airpower theories always tried to define the added-value of the strategic bombing in terms of psychological or systemic effects to be achieved on the enemy. The doctrine of precision effects on the enemy strategic systems, which represents the US approach, is 70 years old, as suggest this statement of the *Air Corps Tactical School* during the 30's: "*Disruption or paralysis of [vital] systems undermines both the enemy's capability and will to fight*"²⁵.

EBO and systemic analysis are concepts developed long ago, now refined and implemented by new enabling technologies. Those concepts became the intellectual foundation of the American air and space power and their allies since the 90's.

EBO principles are part of the USAF doctrine since 1997-98. As pieces of a method, EBO elements (i.e. effects, target systems) have been integrated within targeting processes around 2000, particularly with Marris "Buster" McCrabb work for the *Air Combat Command*.

Besides EBO have been erected as a centerpiece of the Rapid Decisive Operations Concept initially conceived by Deptula and further developed around 2000 by the US *Joint Forces Command* which was responsible for the Joint Experimentation supporting the Force Transformation. From 2003, EBO became a major JFCOM joint and multinational concept on its own. For the Norfolk-based concept developers, effects are not exclusively linked to military actions but more broadly to the full-spectrum of diplomatic, military, economical and informational actions of the coalition²⁶.

The concept has yet experienced heavy criticisms from the Army and Marines while JFCOM did not succeeded in clarifying some key notions and in producing some actionable process.

In 2006, *Joint Publications 3-0* and *5-0*²⁷ finally took into account several key EBO elements: the "Effect" notion, the systemic perspective of the operational environment and the MoEs/MoPs-based assessment. Nevertheless, these doctrine documents retain the current decision making processes. Ground Services were not alone to criticize EBO. Diplomats and development communities, more and more involved in interagency and unified actions concepts and experiments, rejected EBO as a too military concept. Finally, the new JFCOM commander, General Mattis (USMC), endorsing all the previous critics, directed his staff to not promote EBO anymore

²⁵ Brigadier General David A. Deptula, *Effect-Based Operations : Change in the Nature of Warfare*, Defense and Air Power Series, Aerospace Education Foundation, 2001, p.7.

²⁶ Joint Warfighting Center, Joint Doctrine Series 7, *Operational Implications of Effects Based Operations* (EBO), US Joint Forces Command, 17 November 2004.

²⁷ US Joint Staff, *Joint Publication 3-0, Joint Operations*, September 2006 & *JP 5-0, Joint Operation Planning*, December 2006, www.dtic.mil/doctrine

beyond the scope of the current authoritative joint pubs, putting an end to the development of the concept²⁸. Nevertheless, EBO remain currently the main philosophy to plan and conduct air and space operations.

2.4 – Air and Space Power Planning and Operations Processes

Air and space operations are organized today around standards of processes and organizations developed and matured by the USAF and American combatant commands, and directly implemented in coalition operations. NATO takes most part of these standards or develops its own which are very similar.

The organization of the Joint or Combined Force Air Component Command (J/CFACC) and their Combined Air Operations Center (CAOC) are now a widely accepted norm for multinational air operations, as well as the processes these structures implement such as the 72 hours-process to plan and conduct the Air Tasking Order, which manage all the daily combat and support sorties (mission, timing, radio procedures, etc.).

Targeting process is also a paradigm of the modern air and space power, within the frame of joint or component planning activities. In its last US version, detailed in *Joint Fires and Targeting Handbook*²⁹, it includes the following phases:

1. *End State and Commander's Objective*: this first phase is related to the operational planning process which directs the targeting. Joint operational planning process, run by the Joint Force Commander includes the following steps:
 - a. The determination of the end state and objectives;
 - b. Mission analysis and situation analysis: it relies on systemic analysis to determine centers of gravity to reach and effects to be obtained;
 - c. The development, comparison and selection of the course of action;
 - d. The development of the concept of operations; and
 - e. The development of the operation plan providing guidance for targeting.

As a complement to the joint process, the *Joint Air Estimate Process* run by the CFACC, uses similar steps to precise objectives, effects, and target systems to be affected by airpower, etc. ;

2. *Target Development and Prioritization*: it consists in analyzing target systems, target sets and targets to be affected, in producing target lists and materials, etc.;
3. *Capabilities Analysis*: previously named *weaponneering*, this phase develops all elements necessary to affect selected targets : target characteristics, weapons to be used, damage criteria and probability, desired points of impact, etc.;

²⁸ General James N. Mattis, "USJFCOM Commander's Guidance for Effects-Based Operations", *Joint Forces Quarterly*, n°51, 4th Quarter 2008, pp 105-108.

²⁹ Joint Warfighting Center, *Joint Fires and Targeting Handbook*, US Joint Forces Command, 19 October 2007, http://www.dtic.mil/doctrine/jwfc_pam.htm

4. *Commander's Decision and Force Assignment*: During this phase, assets are assigned to targets ; the plans (Master Attack Plan, ISR, C² and Support Plans) are developed then integrated within ATO to be run 12 hours later;
5. *Mission Planning and Force Execution* : the preparation and the execution of each units to the assigned mission and associated tasks;
6. *Assessment*: During this phase, physical and functional damages to targets are assessed, as well as the consequences of those damages on the target sets and target systems. Besides, tactics and armament are also assessed.

This targeting process is fully integrated with the Air Tasking Order process. It requires a precise and rigorous implementation throughout all the campaign. Such kind of organizations and processes, with some national and NATO variants, shape the employment of airpower in all major operations, at least in the western world and its allies.

2.5 – Air and Space Power Flexibility

Another paradigm of the air and space power is its flexibility provided by the exploitation of the concept of *Network-Centric Warfare* (NCW) invented by Admiral Cebrowski and John Gartska in 1998³⁰.

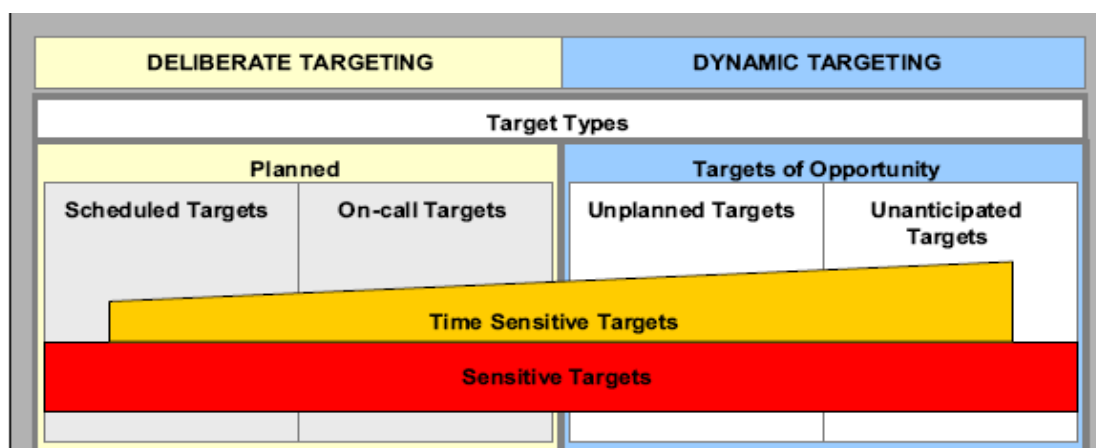
NCW represents the conceptual outcome of twenty years of research regarding the exploitation of the new information technologies for military operational purpose. The added-value of these technologies was the centerpiece of the *offset strategy* developed by the Pentagon at the end of the 1970's to counterbalance the large Soviet quantitative superiority in conventional weapon systems. The Soviets then estimated that the United States were starting a "military-technical revolution" giving to conventional forces capabilities to some extent equivalent to the nuclear ones.

In the aftermath of Desert Storm, the Americans took over the Soviet thinking with the hotly debated issue of revolution in military affairs. The Pentagon took it formally into account in the 1997 Quadrennial Defense Review, as the objective of the transformation of US armed forces.

As a reminder, NCW proponents state that netting sensors, C² and strike assets allow to share the same situational awareness and orders and to self-synchronize more rapidly and efficiently than a force composed of assets operating individually with a vertical hierarchy.

NCW transcription for air and space power emerged progressively at the end of the 1990's with such data-links as link-16 for air defense and air superiority and with a new rapid targeting process complementing the deliberate one. In this former matter, the deliberate targeting process allows to deal with planned targets. But, during the conduct of operations, within each ATO, there are a lot of targets of opportunity which have not been planned or even anticipated.

³⁰ Vice Admiral Arthur K. Cebrowski, John J. Garstka, "Network-Centric Warfare: Its Origin and Future", *US Naval Institute Proceedings*, January 1998.



source : Joint Warfighting Center, *Joint Fires and Targeting Handbook*, US Joint Forces Command, 19 October 2007, http://www.dtic.mil/doctrine/jwfc_pam.htm, p.I.5.

The USAF and Navy developed *Dynamic Targeting* mechanisms, which now take place in the phase 5 of the targeting process, *Mission Planning and Force Execution*. This new rapid process is composed of the cycle F2T2EA (*Find, Fix, Track, Target, Engage, Assess*).



Source : Brig Gen Jim Morehouse, USAF, « Time-Critical Targeting », *DoD Interoperability Conference, National Defense Industry Association*, 25-28 mars 2002, www.dtic.mil/ndia/2002interop/morehouse.pdf

The first elements of this new process were developed and tested by USAF in the *Experiment Force* (EFX) 98, which became a joint experiment the following year (JEFX 99, 2000, 2002, etc.). These experiments allowed developing new CAOC

deployment and operations procedures as well as new required tools of the Theater Battle Management Core Systems.

First operational implementation of the dynamic targeting took place during *Allied Force* campaign Serbia in 1999³¹. This process, used to detect and destroy Serbian mobile surface-to-air missiles and fighters, gave mitigated results. Beyond many technical challenges, the great problem was that this process functioned as a stand alone mechanism.

However, in 2001, during *Operation Enduring Freedom*, the process became more mature and integrated and gave tremendous results. But uncertainties remained regarding responsibilities to deal with the most sensitive targets (*Time-Sensitive Targets, TST*), notably enemy leaders and weapons of mass destruction. Mullah Omar's escape, rendered possible by confusion in the authorizations to fire, gives an illustration of these frictions. During *Operation Iraqi Freedom*, in March-April 2003, despite some remaining problems of integration, dynamic targeting was extensively used: 156 sensitive targets and 686 other dynamic targets were struck during that campaign³². During the counterinsurgency campaigns in Iraq and Afghanistan, dynamic targeting against unplanned and "on-call" targets represents almost all strike activities.

2.6 – Air Power as a Key Contributor to the Defeat Mechanisms of an Adversary

For two decades, air and space power tends to provide the major part of kinetic effects of the joint campaign against a conventional adversary, ground power appearing as the way to maximize effects obtained through the use of the third dimension.

2.6.1 – *Defeat Mechanisms: How they Work*

Extensive German, British and American works³³, dealing with the definition of maneuver warfare across the 20th Century, try to figure out the mechanisms which lead to the defeat of a military power on the battlefield. The following model represents an attempt to summarize these mechanisms.

Historical experiences demonstrate that victory against a military opponent is obtained through mechanisms cumulating effects reached by the combination of fire, maneuver and information on three dimensions of warfare: physical, mental and moral.

➔ Fire encompasses artillery and airpower strike.

³¹ On TST see John M. Fyfe, Lt Col, USAF, *The Evolution of Time Sensitive Targeting: Operation Iraqi Freedom Results and Lessons*, Research Paper 2005- 02 Airpower Research Institute, College of Aerospace Doctrine, Research and Education, 2005.

³² CENTAF, Assessment and Analysis Division, *Operation IRAQI FREEDOM, By the Numbers*, April 30 2003, p.9.

³³ See Hans DELBRÜCK, *History of Warfare in the Framework of Political History*, Third Edition, London, 1920 ; Major Douglas DELANCEY, *Adopting the Brigadier General (Retired) Huba Wass de Czege Model of Defeat Mechanisms Based on Historical Evidence and Current Need*, School of Advanced Military Studies United States Army Command and General Staff College, Fort Leavenworth, Kansas, 2001 ; Robert R. Leonhard, *The Art of Maneuver : Maneuver Warfare Theory and Airland Battle*, Presidio Press, CA, 1991 ; James J. Schneider, "A New Form of Warfare", *Military Review*, January-February 2000; US Joint Forces Command, Joint Futures Center, *Major Combat Operations Joint Operating Concept*, Final Draft, version 2.0, July 2006.

- ➔ Maneuver is the physical move of forces to gain positional advantages in time and space over enemy forces in order to destabilize it. Among key enablers for success of the maneuver are the surprise and the use of deception, which lead the enemy to counter maneuver that is prejudicial to its own interests.
- ➔ Information as an operational instrument corresponds to the notion of Information Operations (IO). Its aims consist in influencing enemy leaders and population and degrading enemy decision making. IO include psychological operations, electronic and cyber warfare.

Three dimensions – according to colonel J.F.C. Fuller, British theorist of the mechanized warfare³⁴ – provide, along with time and space, the framework of all military confrontation: The physical dimension expressed in terms of offensive and defensive power and movement capacity; moral dimension expressed in terms of courage, fear and collective action; and the mental dimension covering the will to fight and the imagination, as well as the process and structure to command and control the forces.

The primary effects of the defeat mechanisms are:

- ➔ **The attrition**: *“The destruction or the neutralization of the physical capabilities of a force and its ability to reconstitute them leading to the reduction of its operational efficiency”* (Definition proposed by authors) ;
- ➔ **The demoralization** : *“Significant loss of individual and collective moral cohesion hindering the will to pursuit organized armed fight”* (Definition proposed by authors);
- ➔ **The disintegration**: *“Inability to conceive and execute a campaign or an operation plan and to keep on a sufficient level of coherence to support the organized armed fight”* (Definition proposed by authors). Disintegration concerns the mental dimension, particularly the decision making and the C² capability;
- ➔ **The overarching effect, outcome of the other ones: Dislocation**: *“To split the force into dissociated and residual elements unable to perform missions and tasks assigned to that force”* (Definition proposed by authors). Dislocation is an effect obtained in the physical dimension.

The defeat mechanisms use also two supporting effects:

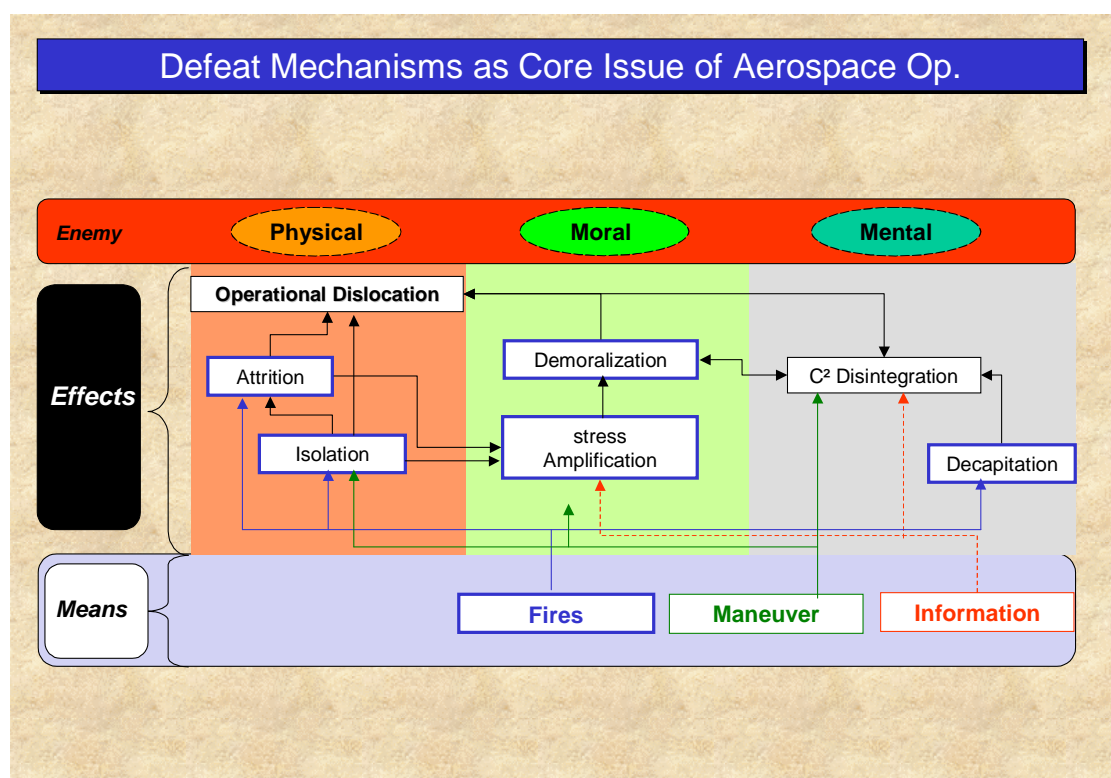
- ➔ **The decapitation**: *“Deprive an entity of its decision-making organization in order to obtain a total or partial functional paralysis”* (Definition proposed by authors). Decapitation can be physically orchestrated by killing or incapacitating the military leadership; or functionally organized by disrupting C3 linkages between command centers and the fielded forces.
- ➔ **Isolation** is an extension of the CSAR term to qualify isolated personnel to be recovered. A proposed definition would be : *“To separate personnel and materials from their initial unit layout by denying lines of communication and retreat, rendering impossible their operational control and support”* (Definition proposed by authors).

³⁴ Colonel J. F. C. Fuller, *The Foundations of the Science of War*, 1926, Combined Arms Research Library of US Army, <http://cgsc.leavenworth.army.mil/carl/resources/csi/fuller2/fuller2.asp>

The combination of fire and maneuver seeks to isolate and attrite adversary forces. This combination increases the individual and collective stress of adversary combatants leading to their demoralization.

Information, fire and maneuver may be also combined to disintegrate the C² of adversary forces. The destructive fire and the offensive information operations will particularly seek - at least temporarily - the decapitation or the isolation and the disorientation of adversary leadership.

Attrition, demoralization and disintegration reinforce each other. For example, a C² apparatus unable to perform its function renders the adversary unable to react to blows, increases demoralization of the elements of the force and enables further attrition by the friendly forces. Conversely, attrition and demoralization tend to increase disintegration through the degradation of the chain of command and the erosion of the will to fight. Those three cumulative effects will mechanically drag the adversary down in the dislocation of its operational force as a coherent system.



In this context, air and space power is expected to have the following generic effects :

- ➔ **At the political level:** a **total and rapid victory** through the application of decisive effects, thus shortening operations, the limitation of friend losses and, to the extent possible, reduced damage in the enemy population;
- ➔ **At the strategic level:** The **disintegration of the organization of the armed forces** through the paralysis or the destruction of enemy strategic centers of gravity and/or decision-making apparatus;

- ➔ **At the operational level:** the **dislocation of the enemy military disposition** through the paralysis or destruction of its operational centers of gravity and the hindering of its freedom of maneuver;
- ➔ **At the tactical level:** the **attrition** of enemy forces and physical resources and the **demoralization** of these forces as well as the combat and mobility **support** of ground and naval operations.

2.6.2 – Air and Space Power as the Main Provider of Fire Projection on Nowadays Battlefields

Air and space power, due to its ubiquity, its reach and its precision, became the main provider of fire onto the modern battlefield and play a key role in the achievement of the defeat mechanisms.

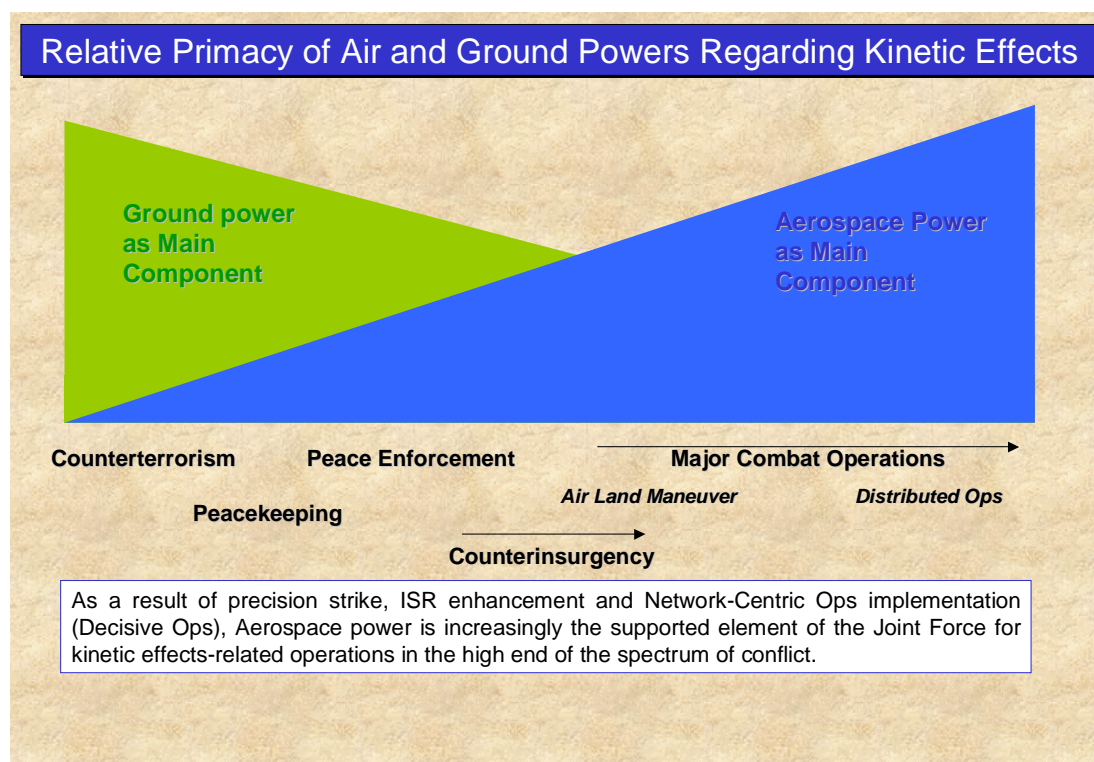
Firstly, it provides a unique capability to intervene throughout all the theater, outside the range of ground force, by strategic attack and battlefield interdiction. Secondly, the close air support may provide the only quick fire support response to mobile ground forces while artillery may be limited by deployment and logistics constraints.

This is a well established reality. The air-ground maneuver operations of the WWII provided ample experience of the capacity of an airpower at the operational and tactical levels. During the crossing of Meuse River in May 40, *Luftwaffe* operated as flying artillery in support of *Panzer divisions*, avoiding the Germans to wait for ground artillery, to keep on the momentum of the maneuver and to overcome unprepared French defenses. At the tactical and operational level, the German and allied air forces represented a persistence hindrance for the enemy maneuver, slowing down tactical movements of the ground forces, degrading the logistics support and finally demoralizing the tactical forces. Nevertheless, even in the 1944 Western Campaign, effective attrition of the enemy ground combat forces remained relatively poor – except for specific high-intensity preparation (i.e. the bombing before *Cobra* breakthrough in Normandy) – and interdiction was never fully achieved.

Today, the technological advances in terms of precision, firepower, all-weather and day/night operations, give the current air and space power far greater capabilities than those available in 20th Century airpower. Moreover, NCW changes dramatically the cooperation with ground forces, introducing better operational information exchange which contributes to upgrade precision and flexibility of engagement through the third dimension. The function of the *Joint Terminal Attack Controllers* (JTAC), spreading among all ground forces to ensure guidance of the close air support, is a perfect example of this evolution.

As a conclusion, it is obvious that technological advances allowed to upgrade in large extend the effectiveness of the air and space power - at least US one - against traditional industrial-age states and their conventional forces, as demonstrated by campaign against Iraq, Bosnian Serbs, and Yugoslavia.

2.6.3 – Conclusion: A Relative Shift in the Primacy of Air and Space Power to Reach Kinetic Effects



The outcome of these transformations is a relative shift between air and ground powers for the achievement of the defeat mechanisms. Fire projection through the third dimension can in many ways become a substitute to the need for ground maneuver.

It is obvious in the planning and conduct of recent major combat operations. US air and space power provided the bulk of efforts leading to the destruction of the Taliban forces in 2001 or the defeat of the Vth Corps in Northern Iraq in 2003. The ground forces operated in both cases as an enabler by provoking the concentration of enemy forces, then rendering them vulnerable to airpower targeting designation. Even in the march-up to Baghdad in 2003, massive air interdiction strikes contribute to isolate, attrite and demoralize the Iraqi Forces to the extent of a full collapse of their operational coherence³⁵. As a matter of fact, air and space power expanded in the operational depth the same kinds of effects reached at the tactical level by dreadful Soviet artillery shelling or allied mass bombing in WWII.

³⁵ Carl Cornetta, *Catastrophic Interdiction: Air Power and the Collapse of the Iraqi Field Army in the 2003 War*, Commonwealth Institute Project on Defense Alternatives Briefing Memo #30, 26 September 2003, <http://www.comw.org/pda/fulltext/0309bm30.pdf>, or Terry McCarthy, "What ever Happened to the Republican Guard", *Time Magazine*, 12 may 2003, pp. 24-28.

If the ground maneuver may be not longer required to create the effects shaping the operational dislocation, it remains the sole way to achieve it and to transform it into the physical collapse of the enemy through: the destruction of enemy residual capabilities; the occupation of the battlefield; and the seizure of the geographic decisive points and centers of gravity. From a political standpoint, as demonstrated by the campaigns in Irak and Afghanistan, ground deployment and maneuver still remain a unique symbol of the strategic commitment and resolution of a coalition.

Air and space power increasing flexibility in conventional warfighting allows it to expand throughout the theater and to sophisticate the attrition effect on less structured paramilitary units in counter-insurgency operations.

2.7 – *The Emergence of a Comprehensive Space Power*

Space power has slowly but consistently evolved since the beginning of the space conquest in the late 50's. Using US joint terminology³⁶, space power has currently four potential functions:

- ➔ *Space Control (CounterSpace for USAF)*. A real dialectic between mastering and denying the use the space dimension does not exist currently, as it exists for air or maritime domains. Nevertheless, the Americans - as well as Europeans to some extent - are now able to develop and maintain a *Space Situational Awareness*. The USA also demonstrated, as the Chinese, a capacity to destroy satellites operating in low orbits. Not surprisingly, the debates on the subject focus extensively on the perspective of a potential confrontation between the US and Chinese in case of a major conflict.
- ➔ *Space Support*. New American concept for *Space Lift* envisages a far more reactive management of space assets than today, with capabilities including reusable systems capable to complement and maintain satellite constellations in short notice. Today, space support shows little flexibility limited by launching capability and the use of spare systems to planning major engagement.
- ➔ *Space Force Application* (meaning force projection from space). This function has currently no applications given the tremendous technological challenges and the fact that space remains for a while a demilitarized zone.
- ➔ *Space Force Enhancement (SFE)*. The support of the air and surface forces either on the theater or for their enduring commitment is currently the core function of the space power and an absolute prerequisite for most of these engagements. SFE encompasses satellite communications (SATCOM), meteorological support, navigation and positioning and, of course, warning and ISR.

Today, one could identify three classes of countries from an air and space power perspective.

- ➔ Most countries have airpower and use SFE services, including the exploitation of meteorological data, GPS signal or the acquisition of commercial imagery. Last commercial satellites (Ikonos, Quickview or GeoEye-1 launched in 2006) demonstrate an increasing resolution and precision that can now compete with some national collection means. However, those countries do not own a real space power

³⁶ US Joint Staff, Joint Publication 3-14, *Joint Doctrine for Space Operations*, 9 August 2002.

and lack therefore strategic autonomy regarding precise and reactive direction of the intelligence collection effort or the access to some data in case of confrontation.

- ➔ Another class of countries owns a more or less comprehensive space power, operating or planning to operate their own warning, ISR or SATCOM assets. Belong to this category Russia, China, India, Japan and the main European countries (France notably). However, the level of integration of air and space operations remains relatively poor and restricted to specific activities.
- ➔ United States appear to be the only ones to enjoy an integrated aerospace power, which means a close coordination of most air and space activities creating mutual synergies to reach more efficiently the same attended effects of an engagement.

PART II – AIR AND SPACE POWER POSTURES BY GENERIC TYPES OF CAMPAIGN

1 – Conventional Campaigning

Air and space power has been primarily conceived in a perspective of international confrontations. Empirical lessons drawn from historical cases as well as the summary of an abundant literature on concepts and doctrines have brought the FRS team to the conclusion that several typical grand strategies can be singled out and developed for studying air and space contribution and main features. At the political level, those grand strategies of confrontation may aim at:

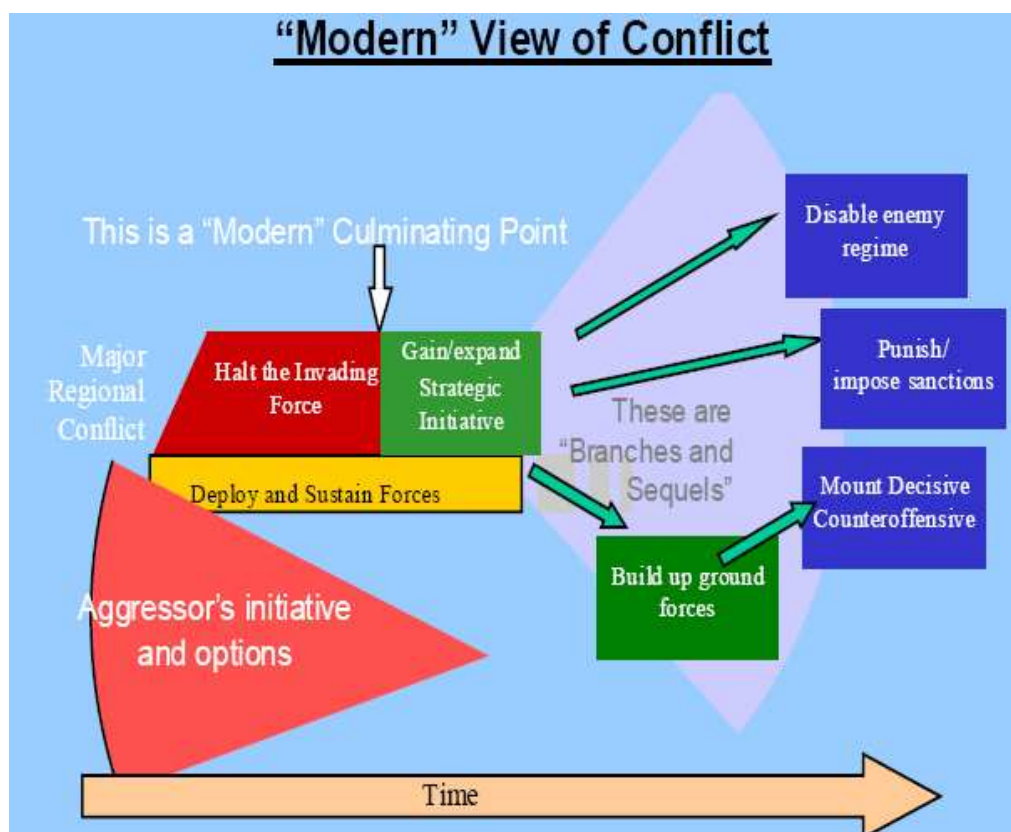
- ➔ Containing a regime;
- ➔ Annihilating a regime;
- ➔ Influencing the behavior of a targeted regime either by deterrence or coercion.

Nuclear deterrence will not be analyzed in the framework of this study, since it is a debated issue among experts about the very nature of this strategy concerning the real use of weapons or only the threat of use. Therefore, that makes sense to focus on three non-nuclear campaigns characterized by a distinct logic in the use of the conventional capabilities. At the political level, these three campaigns could have the following purposes:

- ➔ A campaign of coercion;
- ➔ A campaign of regime change;
- ➔ And as a potential initial phase common to both campaigns, an operation to seize the initiative over an adversary undertaking an offensive action.

1.1 – Seizing the Initiative: The Most Challenging Phase of Conventional Campaigning

This initial phase to seize the initiative corresponds to the concept of “Halt-Phase strategy” developed by USAF in 1997-98 to thwart rapidly an offensive of Iraq or North Korea. It seeks to reduce the degree of initiative and options left to the adversary and focuses on an operational-level force-on-force confrontation.



Air Force Doctrine Document 2-1, *Air Warfare*, 22 January 2000, p.6

The phasing of the campaign encompasses three objectives:

- ➔ First, gaining air superiority;
- ➔ Second, granting access to the theater by the joint forces;
- ➔ Third, hindering the offensive of the adversary forces.

1.1.1 – Gaining Air Superiority

Threats against the airpower in conventional engagement have been extensively described for many years. Main components of Integrated Air Defense Systems (IADS) should consist in for the near and midterm:

- ➔ A network of early warning and reporting assets and a C² system allowing to operate as an integrated system combining air-to-air and surface-to-air means;
- ➔ 4th generation fighters, very maneuverable, equipped with multi-targets offensive avionics and fire-and-forget air-to-air missiles; and
- ➔ Mobile batteries of sophisticated long-range surface-to-air missiles (SAM).

The more an IADS is integrated, the more its coherence is vulnerable to the air strikes. The main challenge for the modern air and space power is the resilience of these assets, notably the SAM. As illustrated by *Allied Force* in 1999, these assets can resist several days or weeks in a degraded mode. A total annihilation of all IADS assets seems unlikely considering the numerous short-range air defense (SHORAD) systems. Therefore, the main desired and achievable effects would be:

- ➔ IADS dislocation as a system through the destruction of alert and reporting elements and C² nodes;
- ➔ The establishment of a lasting freedom of maneuver in mid to high altitude permitting the ISR and follow-on strike to operate.

These effects can be achieved by interdiction strikes on command centers and airfields, SEAD actions against SAM systems providing the greatest volume of coverage, supported by information operations such as electronic warfare and potential offensive cyber-warfare to penetrate and degrade C² systems.

1.1.2 – Granting Access to the Theater by the Joint Force

Air superiority itself contributes to this objective. Besides, granting access may demand to destroy or at least neutralize adversary naval access denial capabilities. It relies on interdiction against surface combatant ships and the support of anti-submarine warfare and mine warfare.

Adversary access denial strategy based on ballistic and cruise missiles capabilities will require attack operations on missiles bases and time-sensitive targeting against transport-erector-launcher mobile vehicles, which would represent the most critical and challenging mission of all this phase.

1.1.3 – Hindering the Offensive of Adversary's Force

This objective would follow the patterns of defeat mechanisms previously exposed:

- ➔ Disintegration of the enemy C² obtained through Information Operations, interdiction strikes;
- ➔ Concentration of the enemy forces to defeat local allied ground forces, supported by potential amphibious and airborne operations;
- ➔ Isolation of these enemy forces through interdiction;
- ➔ Attrition of these forces through close air support and interdiction;
- ➔ Demoralization of enemy through the combination of previous kinetic effects reinforced by offensive information operations; and
- ➔ Finally, dislocation of the enemy operational layout.

Each objective of this operation would represent a line of operations as well as the focus of one phase of the concept of operations. The air superiority and access to the theater would be the first two phases simultaneously operated. The hindrance of enemy offensive would represent the focus of the third phase. The operation would last from several days to a couple of weeks.

In this kind of campaign, the added-value of the air and space power is obvious. It can uniquely produce effects on adversary forces, which are already engaged, thus displaying vulnerabilities. The synergy with local and coalition ground forces would be keys to obtain the defeat of the enemy, air and space being unable on its own to decisively obtain the dislocation.

Nevertheless, air and space power is still confronting major challenges even today. Firstly, gathering enough firepower and highly demanded dynamic targeting systems is time consuming; Secondly air and space power deployment could significantly be

hampered by access denial strategies. A cunning opponent may orchestrate diplomatic pressures on foreign neighboring states to persuade them to deprive an international coalition deployment from the support or host nations. Denying access activities may also include military actions such as the threat or the preemptive use of ballistic missiles against bases of the coalition, threatening further deployment and follow-on operations. Strategic bombers and carrier-based airpower may somewhat mitigate the challenge, but the USA have the only sufficient firepower capability to wage such campaign on its own.

1.2 – Coercion Campaign

Coercion campaign, seeking for the change of behavior of an opponent, relies primarily if not exclusively on air and space power, which one has been conceived for that purpose.

1.2.1 – Strategic Mechanisms for Coercion

Coercion strategies are based on theoretical assumptions explaining the way air and space power can influence the political and strategic calculus of a targeted government or a policymaker.

For Robert Pape, author of one of the most quoted and debated thesis on this matter, coercion is about the rational calculus of a leader considering the benefits and costs he experienced or expects of the pursuing of his resistance. More precisely, Pape states that “*when the benefits that would be lost by concessions and the probability of attaining these benefits by continued resistance are exceeded by the cost of resistance and the probability of suffering these costs, the target concedes*”³⁷. Papes’ approach is hired from theory of a rational decision making as developed by Graham Allison, who analyzed the US Government behavior during the Cuban missiles crisis³⁸. This approach is criticized by other authors:

- ➔ Major Kimminau (USAF) tries to explain coercive mechanism by adapting to strategy the *Prospect Theory*, developed by Daniel Kahneman & Amos Tversky in 1979 to model the behavior of financial and economical actors. This theory states that the calculus of a decision maker, far from being rational, depends on his subjective estimate and the circumstances. For example, his end state is highly relative. His propensity to take risks is differing whether he estimates himself in a winning or losing situation. In that case, the aversion to losses could bring the leader to accept more risks to balance the situation³⁹.
- ➔ The *Second Order Change theory* suggested by colonel Engelbrecht (USAF) states that coercion modifies the behavior of the targeted decision maker when he realizes that the continuation of the resistance put at stake new and broader interests (including the survivability of the leadership system itself) non previously taken into

³⁷ Robert Pape, *Bombing to Win: Air Power and Coercion in War*, Cornell Studies in Security Affairs, Ithaca and London, Cornell University Press, 1996, p. 16.

³⁸ Graham Allison *Essence of Decision: Explaining the Cuban Missile Crisis*, 1971. Little, Brown

³⁹ Kimminau Jon A., Major, Usaf, *The Psychology Of Coercion:merging Airpower And Prospect Theory*, Thesis, school of Advanced Airpower Studies, June 1998.

account. This change can occur after significant events happened, or when appear new stakeholders⁴⁰.

1.2.2 – *The Operational Strategy for Coercion*

Coercive air and space power may be employed according to four kinds of operational strategy: punishment, denial, risk and paralysis.

Punishment strategy seeks to produce mass-terror by striking indiscriminately population and civilian resources to provoke a rapid uprising or collapse. Conceived by the Italian general Giulio Douhet after WWI, it had been implemented by the Germans en 1940 in the second phase of the Great Britain air battle; by the British on Germany from 1943 to 1945 and by the Americans on Japan in 1944-45. The only success of this strategy had been obtained by the use of the atomic bombs on Hiroshima and Nagasaki. But the punishment strategy is relegated to History manuals, since killing mass of civilians is now deemed as a crime against humanity and is no longer admitted by members of the international community.

Denial Strategy is considered by Robert Pape as the most successful coercive approach from a historical standpoint. “*Denial strategies target the opponent’s military ability to achieve its territorial and other political objectives, thereby compelling concessions to avoid futile expenditure of further resources*”⁴¹. Denial strategy can be realized at the three levels of war:

- ➔ At the strategic level, it corresponds to the destruction of the resources necessary to the continuation of the armed resistance. It can be either narrowed on a restricted number of target systems contributing directly to the military strategy or directed against broader system of resources of the targeted entity;
- ➔ At the operational level, it means isolating the enemy forces, hindering their deployment and employment. It includes air mission of Battlefield Area Interdiction ;
- ➔ At the tactical level, it means the attrition of the enemy forces.

Strategic interdiction characterized the doctrine of the *Air Corps Tactical School* of 1935, implemented during American air campaign against Germany in 1943-44. This campaign targeted unsuccessfully several industrial systems before achieving devastating effects on the Petroleum Oil and Lubricant system.

Denial is often synonymous of military victory. In the case of Japan, according to Robert Pape, the interdiction of the sea lines of communication coupled with the rapid collapse of the Japanese forces attacked by the Soviets in Mongolia, three days after Hiroshima, would have convinced the military leadership of the futility of its defensive plan. Denial strategy thereby led to a consensus among the Japanese leaders in favor of an immediate surrender, what the atomic bombing alone would not have suffice to achieve. In 1972, *Linebacker* campaigns suppressed temporarily the North Vietnam offensive capabilities and compelled its leadership to reengage negotiations in Paris. *Desert Storm* represents too an example of successful denial strategy, the loss of the

⁴⁰ Joseph Engelbrecht, *War Termination: Why Does a State Decide to Stop Fighting?*, Ph.D. dissertation, Columbia University, 1992.

⁴¹ Robert Pape, *Bombing to Win: Air Power and Coercion in War*, Op. cit, p.19.

Kuwait and the risk of destruction of the republican guard compelling Saddam Hussein to give up. Nevertheless, as depicted before, a true denial strategy is the result of a joint campaign, and is rarely a success when only operated by airpower.

Risk strategy has been developed, as an example of theory of limited war in time of nuclear deterrence, by Thomas Schelling under the term of Compellence. It targets a broad area of objectives, from military to societal elements, as the punishment strategy, but follows a far different mechanism. The idea is to compel an adversary by making him to anticipate an increasing cost of resistance by a progressive escalation of aerial bombings. Schelling's risk manipulation strategy has three main characteristics:

- ➔ The discriminated use of force, as opposed to the brutal force;
- ➔ The anticipation by the targeted opponent of the future risk: *"Coercion depends more on the threat of what is yet to come than on damage already done"*;
- ➔ The permanent search for a negotiated settlement: *"The pace of diplomacy, not the pace of battle, would govern the action...the military action must communicate a continued threat"*⁴².

Rolling Thunder, the U.S. air campaign against North-Vietnam in 1965-68, has been inspired by this theory. It failed miserably due to a poor assessment of the Vietnamese political strong resolve and the operational constraints imposed by the Johnson Administration. Conversely, *Allied Force* the US/NATO air campaign against Serbia in 1999, although hastily improvised, represented finally a good example of the risk strategy. Milosevic gave up after the Russians withdrew their support, exposing the Serbia President to an increasing diplomatic isolation. He came across the conclusion that he could anticipate further western carpet bombings on Belgrade. As he stated later, *"we knew that when the Russians came in with this plan, that was it. We knew it from the beginning. We knew that the carpet bombing of Belgrade would start the next day after we refused"*⁴³.

Paralysis strategy is not new. Hugh Trenchard, JFC Fuller or Sir Basil Liddell Hart brilliantly outlined the perspective of strategic paralysis immediately after WWI. The most famous supporter of the indirect approach estimated that *"Provided that the blow be sufficiently swift and powerful, there is no reason why within a few hours, or at most days from the commencement of hostilities, the nerve system of the country inferior in air power should not be paralysed"*⁴⁴. Paralysis represents the preferred strategy of coercion of the current US doctrine. Indeed, it underpins the models proposed by John Warden and Jason Barlow. For the former, *"The idea of paralysis is quite simple. If the enemy is seen as a system, we need to identify those parts of the system which we can affect in such a way as to prevent the system from doing something we don't want it to do"*⁴⁵. The strategic paralysis is largely synonymous of the decapitation, either functional or physical, of the leadership of the enemy system and let aside the targeting

⁴² Thomas Schelling, *Arms and Influence*, New Haven: Yale University Press, 1966, p. 172.

⁴³ Stephen T. Hosmer, *The Conflict Over Kosovo: Why Milosevic Decided to Settle When He Did*, MR-1351-AF, Rand Corporation, Santa Monica, 2001, p 94.

⁴⁴ Basil H. Liddell Hart, *Paris, Or the Future of War*, New York: Garland Publishing, Inc., 1972, c1925, 40-41 quoted in David S. Fadok., *John Boyd and John Warden: Air Quest's for Strategic Paralysis*, School of Advanced Airpower Studies, Air University Press, Maxwell AFB, Alabama, February 1995, p.6.

⁴⁵ John A. Warden, *Air Theory for the 21st Century*, in *Battlefield of the Future*, September 1995, <http://www.airpower.maxwell.af.mil/airchronicles/battle/bftoc.html>

of the enemy fielded force. Contrary to the risk strategy, it requires a massive and immediate use of airpower to create a shock effect and to prevent adversary to adapt. The most ambitious – and less clearly defined – of the strategic paralysis is the *Rapid Dominance* theory suggested by Harlan Ullman & James Wade of the National Defense University in 1996: “*The key objective of Rapid Dominance is to impose this overwhelming level of Shock and Awe against an adversary on an immediate or sufficiently timely basis to paralyze its will to carry on. In crude terms, Rapid Dominance would seize control of the environment and paralyze or so overload an adversary’s perceptions and understanding of events so that the enemy would be incapable of resistance at tactical and strategic levels*”⁴⁶. Despite all these theories, a successful systemic paralysis has never been achieved. *Instant Thunder* the strategic bombing campaign of *Desert Storm* was a failure according to most of the assessments⁴⁷. The strategic air campaign of *Iraqi Freedom* gave the same poor results, Saddam Hussein keeping until the very final stage of the joint campaign a minimal capacity to manage his means.

To sum these different coercive operational strategies, we use the table made by the Major Pray (USAF) in his thesis for the Air University.

Comparative Analysis Summary				
THEORIST	TIMING	TARGET	MECHANISM	OUTCOME
Douhet	Immediate	Population	Lower morale	Policy change
ACTS	Rapid	Economy	Revolt	
		"Industrial web"	Social	Policy change
Schelling	Gradual	Population	disintegration	
Warden	Instantaneous	Leadership	Future costs	Policy change
			Decapitation	Policy change
			Strategic paralysis	

Source : John I, Major Pray, *Coercitive Air Strategy, Forcing a Bureaucratic Shift*, Thesis, school of Advanced Airpower Studies, Maxwell AFB, June 1995, p. 15.

1.2.3 – Reconstitution of a Generic Campaign of Coercion

Given the scope of possible strategies and doctrinal preferences, we will focus our example of on *Allied Force*-like campaign with the stand alone employment of airpower against a regional power considered as a dangerous outcast by the international community.

As LTC Hinman (USAF) demonstrated perfectly⁴⁸, every approach of the coercive operational strategy already exposed in the previous section has its limits. Even the

⁴⁶ Harlan Ullman & James Wade, *Shock and Awe, Achieving Rapid Dominance*, Institute for National Strategic Studies, National Defense University, 1996, p. xxv.

⁴⁷ See for example, Robert Pape, Op cit, Benjamin S. Lambeth, *The Transformation of American Air Power*, Cornell Studies in Security Affairs, Cornell University Press, 2000, p. 147. and Thomas A. Keaney and Eliot A. Cohen, *Gulf War Air Power Survey*, vol. 2, *Operations and Effects and Effectiveness*, Department of the Air Force, 1993, 278–79.

⁴⁸ Lieutenant-colonel (USAF) Ellwood P. “Skip” Hinman IV, *The Politics Of Coercion Toward A Theory Of Coercive Airpower For Post–Cold War Conflict*, CADRE Paper No. 14 Air University Press, Maxwell Air Force Base, August 2002.

most promising denial option is based on the sometimes flawed assumption that the enemy has a clear perception and articulation of his own strategy. Therefore, we agree with LTC Hinman when he considers that the best operational strategy for coercion should be an hybrid option, combining denial, risk and paralysis approaches. The objectives of this strategy would be therefore:

- ➔ **Gaining air supremacy.** The supremacy is the ultimate achievement of superiority and follows a similar pattern. In that case all enemy air defense capabilities are destroyed or at least incapacitated throughout the theater leaving air and space movements unopposed.
- ➔ **Degrading significantly enemy offensive capabilities.** This effort has two objectives:

- ⇒ First, to **preempt any enemy retaliation** to the ongoing coercive campaign;

- ⇒ Second, to **prevent the reconstitution of future potential military strategy** of an hostile regime, in targeting the usable offensive capabilities in future operations.

Interdiction strikes and strategic attack may destroy or neutralize enemy HVTs, such as critical conventional capabilities as well as the system of weapons of mass destruction and ballistic missiles, including production and storage facilities and fielded units.

- ➔ **The strategic coercion itself.** It would use systemic paralysis or risk strategies, or a mix of both depending on the target systems and the circumstances. Two kinds of target systems would be attacked. On the one hand, selective strategic attack combined with information operations (mainly electronic and cyber warfare and PSYOP) would target the facilities of the political and military leadership, the propaganda machine and the C3I systems in order to degrade the leadership system at a whole. On the other hand, other selective strategic attack would degrade or disrupt temporarily the elements of the resource system of the entity which contributes to the foundation of the enemy leadership. It would include such target sets as lines of communication, industries, power production, Petroleum – Oil – Lubricant system, etc.

A coercive campaign is confronted with many challenges. The resilience of the enemy systems implies persistent air and space operations. The measures of Camouflage, Concealment, Deception (CCD) and the distribution of key functions of the leadership system will reduce the vulnerability of the enemy entity, what may require a protracted engagement. The coercive entity will face the enduring lack of intelligence on the intentions and the psychological situation of the targeted leadership. Nevertheless, the coercion of this leadership, which is an adaptive system, will require reassessment and reorientation of the strategy on a regular basis to maintain the suitability of the effort. Finally, the strategic attack implies a very high risk of collateral damages with unpredictable effects, when exploited by the propaganda of a skillful enemy. For all these reasons, the coercive campaign option remains the most hazardous employment of the air and space power.

Last but not least, coercion requires a clear superiority of the coercer over the targeted entity, what means that only great powers and coalition are able to perform this kind of strategy.

1.3 – Campaign of Regime Change

As demonstrated by several examples from World War II to *Iraqi Freedom*, a campaign of regime change is the most demanding and challenging conventional engagement. It requires a joint campaign, since the decapitation of the enemy leadership by airpower has never been proved successful.

When designing such campaign as OIF, it appears that the regime change will proceed from the achievement of three objectives: the overcome of enemy anti-access and area denial, including the air supremacy, condition sine qua non for the follow-on objectives; the denial of the enemy defensive strategy; then finally the suppression of the regime. Three major effects will serve these objectives:

- ➔ **The systemic paralysis.** The degradation of the leadership would aim the same targets as described for coercion but would be far more lethal and brutal, without any risk or escalation approach since the goal is not the compellence. Conversely, the desired effect on resources system would be the disruption more than the enduring degradation of its major functions supporting the regime. Indeed, temporary disruption allows a more rapid recovering of all those assets during the stabilization and reconstruction of the entity.
- ➔ **The dislocation of the enemy forces** will be obtained through the mechanisms of defeat previously described.
- ➔ **The occupation of a part or the whole enemy territory** will be implemented by the air-ground maneuver, air and space power providing CAS, ISR and airlift support.

A campaign of regime change is probably the most complicated, costly and resources-consuming engagement. Even more than the coercion, it requires an undisputed superiority of capabilities over the enemy. From the political standpoint, it is the most difficult engagement to manage, considering the following challenges of stabilization and reconstruction at the end of the conventional campaign. However, the achievement of the intrinsic objectives is far less hazardous than the coercive air campaign since it does not seek a change of the behavior of the adversary.

1.4 – Required Capabilities for Conventional Campaigns

1.4.1 – Counterair

Counterair includes all activities to counter any threats in or transiting through the third dimension. Formally, it is “*a mission which integrates offensive and defensive operations to attain and maintain a desired degree of air superiority. Counterair missions are designed to destroy or negate enemy aircraft and missiles, both before and after launch*” (US JP 1-02)

Defensive counterair (DCA) encompasses an active part, the air and missile system, and a passive part, the measures of CCD, dispersion, redundancy, hardening and mobility of ground elements.

Recent engagements did not present a lot of challenges of DCA for the airpower of the western coalitions. Either airpower is confronted to asymmetric entities which do not have any threatening capabilities in that domain or it has been used against states having very few DCA capabilities, such as Iraq. This does not mean that in future engagement,

DCA will not figure at the forefront of the challenges of a commander. The active defense against air or missiles strikes is well taken in account with the fielding of modern fighters and air defense systems as well as recent missile defense capabilities. However, the vulnerability of the deployed forces and their bases – not only the main operating base or forward operating bases on the theater but also to intermediate staging bases – is obvious. An *ad hoc* coalition engagement means the deployment, in short notice, of important forces onto overcrowded facilities often unprepared for that and lacking elementary passive protection. Such facilities offer a target of choice for the adversary and could suffer major damages from a attack of ballistic missile, with sub-munitions warheads, penetrating the missile defense layout⁴⁹.

Offensive Counterair (OCA) encompasses four basic kinds of missions:

- ➔ Surface attack;
- ➔ Fighter sweep;
- ➔ Escort; and
- ➔ Suppression of enemy air defense.

Surface attack and SEAD are the most effective missions to destroy enemy IADS and its air and missile offensive capabilities. Nevertheless, the resilience of these capabilities will require persistent missions. During *Desert Storm*, one hundred of SEAD sorties were executed on a daily basis, even after coalition declared to have gained the air superiority. Beyond the regular re-strikes of key fixed assets such as airfields, the persistence of effects means to deploy a permanent dynamic targeting layout to timely detect and neutralize mobile surface-to-air missile systems and cruise and ballistic missiles launchers. During OIF, 23% of the dynamic targeting missions executed in support of the Combined Joint Special Operations Task Force – North and the Kurds Peshmergas were dedicated to SEAD and the destruction of portions of IADS⁵⁰.

More broadly, counterair represented the second effort of the CFACC apportionment of the sorties in the recent conventional campaigns. For instance:

- ➔ During *Desert Storm*, 23 745 counterair sorties (13 000 of which were offensive) represented 20% of 118 661 sorties of the coalition⁵¹;
- ➔ During OIF, CFACC apportioned 14.1 % of its capabilities to counterair⁵².

There is no need to elaborate further on the requirements for air superiority fighters, offensive electronic warfare and antiradar missiles or PGMs as counterair critical capabilities. However, UAV or UCAV may be more noteworthy to mention. A first

⁴⁹ John Stillion, David T. Orletsky, *Airbase Vulnerability to Conventional Cruise-Missile and Ballistic Missile Attacks : Technology, Scenarios, and U.S. Air Force Responses*, MR 1028, Project Air Force, Rand Corporation, 1999.

⁵⁰ John M. Fyfe, Lt Col, USAF, *The Evolution of Time Sensitive Targeting: Operation Iraqi Freedom Results and Lessons*, Research Paper 2005- 02 Airpower Research Institute, College of Aerospace Doctrine, Research and Education, 2005, p.25.

⁵¹ Lewis D. Hill, et al. *Gulf War Air Power Survey*, vol V, 1993, pp.232-233, <http://www.airforcehistory.hq.af.mil/Publications/Annotations/gwaps.htm>

⁵² Lt Gen T Michael Moseley, *Operation Iraqi Freedom, By the Numbers*, Assessment and Analysis Division, CENTAF, April 30 2003, p. 5.

kind of employment is the use of cheap UAVs as decoys to localize enemy SAM systems in SEAD missions, as extensively used by Israelis during Lebanon operations in 1982. Counterair, especially SEAD, represents currently with ISR the best justification for a modern stealth UCAV. According to a recent CSBA study regarding the Navy UCAS-N program⁵³, this kind of asset enjoys significant advantages over current manned platforms:

- ➔ The stealth characteristic would offer a deep penetration ability in hostile environment;
- ➔ The endurance of tens of hours would offer a radius of action expanded by 1000 NM, allowing operations from distant bases, outside the radius of short-range ballistic missiles. Carrier-based UCAV would offer operational capabilities as soon as the end of the transit of the battle group, thus beginning the degradation of the adversary area denial capabilities from 2-3 days before areas of operations fall within the radius of action of F-35 or F/A-18 – like aircrafts;
- ➔ This endurance is also well suited to allow the loitering over the battlefield for the purpose of the dynamic targeting.

1.4.2 – Counterland

Counterland is defined by “*Air and space operations against enemy land force capabilities to create effects that achieve joint force commander objectives. The main objectives of counterland operations are to dominate the surface environment and prevent the opponent from doing the same*” (AFDD 1).

In other words, the counterland is the domain of the airpower that contributes primarily, with the information operations, to the defeat mechanisms of the enemy. It encompasses two broad kind of missions:

- ➔ Close Air Support (CAS), the air action by fixed- and rotary-wing aircraft against hostile targets that are in close proximity to friendly forces and that require detailed integration of each air mission with the fire and movement of those forces (US JP 1-02);
- ➔ Air Interdictions (AI) conducted to destroy, neutralize, or delay the enemy's military potential before it can be brought to bear effectively against friendly forces at such distance from friendly forces that detailed integration of each air mission with the fire and movement of friendly forces is not required. (US JP 1-02).

One the most significant issue for counterland is how to grant the best synergy of the joint operations while avoiding fratricide fire. In the United States, the management of the geographic responsibilities of CFACC and CFLCC for the fire management is debated since the 1982 US Army *Airland Battle* manual. For 20 years, doctrine recommended the establishment of a Fire-Support Coordination Line (FSCL) 100 km ahead of the friendly lines, in which the ground commander was responsible of the fire coordination, excluding any kind of air strikes. To fix problems of lack of flexibility this arrangement implied, the theater space has been reorganized during OIF as a grid of kill boxes, opened or close depending on the presence of friendly ground forces in the vicinity.

⁵³ Robert O. Work, Thomas P. Ehrhard, *The Unmanned Combat Air System Carrier Demonstration Program: A New Dawn for Naval Aviation?*, Center for Strategic and Budgetary Assessment, 2006.

At a whole, some elements regarding required capabilities may be noteworthy:

- ➔ Counterland demands the ability to generate several hundreds of daily offensive sorties. During OIF, for each ATO, CFACC executed near 700 to 800 sorties – 50,7 % of the CFACC capabilities apportionment – dedicated to CAS and to interdiction of the Republican Guard. With an average of daily sorties per combat aircraft, counterland operations against a state conventional opponent require several hundreds of strike platforms.
- ➔ All those aircrafts must be precision-capable, all-weather, night-capable and integrated in the C² network, that means equipped link-16 datalinks or future standards.
- ➔ Attack helicopters used in interdiction missions are highly vulnerable to enemy SHORAD means which can never be fully eliminated. Therefore, those assets must remain confined to their historic role of CAS, leaving aircrafts and cruise missiles as the main interdiction assets.
- ➔ UCAV represents key platforms for dynamic and time-sensitive targeting. USAF accelerated its program, with the objective to deploy permanently in support of the Middle-East campaigns 27 Combat air patrol – each requiring 3 UAV and 2 ground stations – of MQ-1 Predator and MQ-9 Reaper (with 3000 lb payloads including PGM). The service seeks to align 50 CAP in 2010⁵⁴.
- ➔ Counterland requires too several thousands of PGM. During OIF, PGM counted for more than 50 % of the total of munitions released in recent conventional campaigns (12 000 PGM for OEF and 18 000 for OIF I, mainly GBU, JDAM and JSOW). More than 80 % of the targets were aimed in CAS and AI missions⁵⁵. Since the “tank plinking” of *Desert Storm* and the demand to reduce collateral damages, PGM are widely used for most enemy ground forces target sets. This means that a counterland campaign, even if waged against one small conventional armed force, will demand no less than several thousands of those kinds of PGM.
- ➔ The requirements for JTAC are growing exponentially (now several tens of personnel for a campaign waged by corps-like ground force) given the increase of the areas of responsibilities of a networked and more distributed ground force and the exploitation of the ubiquity and firepower of the air power⁵⁶.

Given the level of required firepower and volume of forces, a complete campaign of counterland aimed to defeat a state seem only feasible with US means or a coalition with US participation. Nevertheless, other national airpower may have sufficient capabilities for interdiction operations that are focused to limited effects as the isolation of a part of the theater of operations and the cutting of some lines of communications.

1.4.3 – Strategic attack

Strategic attack is the “*offensive action conducted by command authorities action aimed at generating effects that most directly achieve our national security objectives by*

⁵⁴ Air Force Public Affairs Fact Paper on ISR and Unmanned Aerial Systems (UAS), April 23 2008, www.defensedaily.com/Assets/File/AF%20ISR%20Fact%20Sheet.doc

⁵⁵ Lt Gen T Michael Moseley, *Operation Iraqi Freedom, By the Numbers*, op. cit.

⁵⁶ See Bruce R Pirnie & alii, *Beyond Close Air Support, Forging a New Air-Ground Partnership*, Project Air Force, Rand Corporation, 2005.

affecting an adversary's leadership, conflict-sustaining resources, and/or strategy". (AFDD 2-1.2)

Quantitatively, strategic attack demands less assets and ammunitions than counterland. Indeed, the number of objectives would usually range from tens to hundreds, not thousands. For instance, the *Instant Thunder* plan developed by Warden was designed to strike no more than 96 strategic targets in Iraq. Conversely, a very precise situational awareness and understanding is required, particularly when considering the structure of the leadership system, the secondary, indirect or undesired effects, which are not similar to the defeat mechanisms on the battlefield. Compared to counterland, a strategic attack option experiences more constraints:

- ➔ In the most cases, leadership systems are intermixed in urban areas;
- ➔ Resources system encompasses many "dual" targets whose the destruction even the disruption may be counterproductive and produce collateral damages to the civilian society;
- ➔ Strategic targets, constituting often HVT for the enemy, would probably be heavily defended.

An important criterion is therefore the selectiveness of the strikes which almost exclusively relies on precision-guided weapons. Strategic attack could also involve:

- ➔ Platforms and weapon systems capable to penetrate sophisticated air defense, most notably cruise missiles and stealth aircraft. For instance, during *Desert Storm*, stealth F-117 *Nighthawk*, while accounting for 2% of the total number of sorties, destroyed around 43% of the fixed strategic and operational targets of the target list⁵⁷. In the future, UCAV might be good candidates to perform such kind of missions, while it is not currently on the top priority list;
- ➔ Non-lethal munitions such as BLU-114 used by Americans to disrupt temporarily the Serbian power plants;
- ➔ Munitions capable to reach hardened and buried targets such as strategic command centers or storage facilities of weapons of mass destruction. Thermobaric bombs like the BLU-118B are good examples of the required type munitions to operate such strategic attacks.

1.4.4 – Command and control

Conventional air and space campaign tends invariably to exceed thousand daily sorties:

- ➔ ODS : 2600 to 2800 sorties with surge to more than 3000, especially during the ground campaign in the last days of the war;
- ➔ OAF : from 200 sorties at the start of the campaign to more than 1000 at the end;
- ➔ OIF : between 1800 and 2000 sorties.

At a whole, 40% of these sorties are offensive (strategic attack, counterland or offensive counterair) and around 40% encompasses mobility operations, airlift and in-flight refueling.

⁵⁷ Government Accounting Office, *Operation Desert Storm: Evaluation of the Air Campaign*, GAO/NSIAD-97-134, June 1997, pp. 125-139, quoted in *ibid.*, p. 203

The planning and conduct of the ATO as well as Battle Damage Assessment-related tasks in conventional campaigns, require more than twenty staff functions, the CAOC - the real center of gravity of the air campaign - must include more than one thousand personnel⁵⁸, a number in continuous increasing.

Riyadh CAOC during ODS counted 880 personnel. Vincenzo CAOC during *Allied Force* had been augmented from 400 to 1300 personnel. In 2003, Riyadh CAOC which had to manage OIF plus OEF, increased its personnel from 672 to 1966⁵⁹. With such demands, the enduring challenge - and shortfalls - is about the qualification of the augmentees drawn from other command to fulfill efficiently the staff positions. For instance, during OEF and OIF, among the 60 staff personnel dedicated to BDA in the CENTCOM HQ, only 4 were permanent specialists of this function.⁶⁰

Enduring challenge of C² is the interoperability. This challenge regards to some extend procedures. As we saw earlier, most US and other NATO personnel use compatible standards. For the US side, OEF and OIF demonstrated an unprecedented level of integration of Navy and Air Force activities, compared to the poor coordination during *Desert Storm*⁶¹. Nevertheless, this compatibility is not synonymous of interchangeability. During OEF, more than 23 different forms of mission report have been used, delaying their exploitation by the CAOC⁶².

Most interoperability concerns are about the communication and information systems. Even though the DoD-level effort made to build-up the Global Information Grid, this interoperability remains an elusive target. Indeed, while the abandon or upgrades of numerous non compatible legacy systems are significant steps to increase the interoperability, the fielding of some new systems, developed by services according to different agenda and detailed requirements, tend to defer indefinitely the problem. For example, in 2005, after ten years of uninterrupted efforts, 156 of the 236 of the Joint Battle Management Command and Control functions were not certified interoperable by the DISA Joint Interoperability Test Command (JITC)⁶³. Fortunately, the recognized authority of the combatant commander and the timeline of some operation planning allow to build ad hoc interoperability, not only between US services but also among coalition partners, except for such functions as the air and missile defense demanding machine-to-machine near-real time automated information exchange (i.e. Cooperative Engagement Capability).

⁵⁸ LCDR Christopher E. Bolt, *JFACC Split, Forwad and Afloat – Positionning for Success*, Naval War College, février 2002, p. 6.

⁵⁹ Anthony H. Cordesman, *The lessons of the Iraq War, Executive Summary*, Eighth working draft, May 14, 2003, Center for Strategic and International Studies, p. 144.

⁶⁰ US General Accounting Office, *Military Operations, Recent Campaigns Benefited from Improved Communications and Technology, but Barriers to Continued Progress Remain*, GAO-04-547 June 2004, p.

⁶¹ Benjamin S. Lambeth, *Combat Pair: the Evolution of Air Force-Navy Integration in Strike Warfare*, Rand Corporation, Project Air Force, 2007.

⁶² US General Accounting Office, *Military Operations, Recent Campaigns Benefited from Improved Communications and Technology*, op cit, p. 3.

⁶³ Gearhart Robert A (Col) Joint Staff/J6I, *Implementing Joint Battle Management Command And Control Roadmap Panel*, briefing at the *Net Centric Operations, Interoperability & Systems Integration Conference*, National Defense Industry Association, March 23 2005, <http://www.dtic.mil/ndia/2005netcentric/2005netcentric.html>

1.4.5 – Intelligence Surveillance and Reconnaissance

In the ISR domain, a distinction should be made between the collection platforms and the sensors.

Air and space power use three kinds of collection platforms: manned reconnaissance aircrafts, UAVs and satellites. Clearly, a conventional campaign takes benefit from the combination of all these assets.

The advantages of the satellites are well-documented: Their global collection area, the avoidance of deployment operations, and the unique capability to provide vertical stand-off electro-optical reconnaissance. Nevertheless, most EO/IR satellites have been developed to point reconnaissance in support of strategic intelligence requirements. The collection depends on the time to revisit. Therefore, they may be not well suited to the reconnaissance of broad areas such as a theater of operations and to the context of dynamic air ground operations. These satellites will be therefore best used to provide imagery regarding fixed infrastructures. On the other hand space-based signals intelligence assets may be more useful to support tactical operations but in any way, the delays in the sharing of these highly-sensitive pieces of information may prevent their timely exploitation.

UAVs represent key platforms of the surveillance of the battlefield and ISR support to tactical and operational levels:

- ➔ Their endurance, reaching tens of hours for HALE / MALE platforms, is superior to any manned aircraft;
- ➔ They are real surveillance platforms capable of continuous observation, without the constraints of time of revisit of orbital assets. Tactical UAV and MALE provide video monitoring of areas (i.e. "Predator Channel" within the CAOC);
- ➔ Their sensors allow stand-off surveillance (i.e. more than 80 km for optical sensors HALE as a *Global Hawk*).

Symbol of capabilities offered by a HALE, the sole *Global Hawk* used during OIF in 2003 has provided, according to the Air Force, 55% of targeting data on Iraqi air defense system, locating and 13 surface to air missiles batteries, and IMINT about 38% of Iraqi tanks. The UAV became the key platform of tactical and operational surveillance and the backbone of the dynamic targeting⁶⁴.

Manned aircraft, for many years, are needed to complement the collection operations of satellites and UAVs. They actually offer several advantages:

- ➔ On the tactical reconnaissance, the "*coup d'œil*" of the pilot of the aircraft provides greater flexibility in carrying out the mission. Moreover, manned reconnaissance also offers the advantage of platforms polyvalence, most of whom are fighters with onboard reconnaissance pods;
- ➔ Large platforms adapted for SIGINT missions (RC-135, EP-3, C-160 *Gabriel*) or battlefield surveillance (E-8 JSTARS) without mentioning such specialized asset as U-2, may board and operate much heavier and powerful sensors.

⁶⁴ John Croft, "Send in the Global Hawk", *Air & Space Magazine*, Smithsonian, January 01, 2005.

Aerospace power succeeds now in performing relatively continuous and comprehensive situation monitoring at the tactical or operational levels, particularly crucial in the operations aiming at seizing the initiative and changing a regime.

During OIF, in 1000 sorties carried out from 19 March to 18 April 2003, the 80 coalition ISR platforms, have made 42000 battlefield images, 2400 hours of SIGINT coverage, 3200 hours of video, 1700 hours radar tracking of moving targets⁶⁵. In other words, more than 30 platforms flew by ATO providing standing SIGINT and video coverage on several areas simultaneously, and nearly 1500 pictures in 24 hours.

However, despite improved performance providing ever more information on the adversary deployment posture and activities, air and space ISR remains particularly ill-suited to glean intelligence of intent, the central intelligence challenge of any military operation.

The table below, based on the French joint doctrine of intelligence, shows that only HUMINT and COMINT are able to provide evidence concerning the enemy moral, perceptions and decisions, in short, his cognitive dimension. However, only a limited number of air and space of platforms carry out COMINT missions, the overwhelming share of their ISR activities being IMINT and ELINT. This limitation, all the more important that the opponent will limit its use of telecommunications, explains to a large extent the wanderings of Battle Damage Assessment and, more broadly, the difficulties of measuring the achievement of the effects on the opponent. This assessment of effects requires a fusion of information at the operational level and beyond at the interagency level. It is based mainly on the intelligence all-source analysis, including the ability to weigh the factors and to convince decision makers of the estimate.

⁶⁵ CENTAF, Assessment and Analysis Division, *Operation Iraqi Freedom, By the Numbers*, op. cit, p. 3.

INTELLIGENCE – SURVEILLANCE – RECONNAISSANCE :				
Sensor value regarding the kind of provided information				
Hosted by air and space collection assets				
Dimensions	Sensors	Information on Physical domain	Information on Informational domain	Information on Cognitive domain
Electro - magnetic	SIGINT	X		X
	(COMINT)	X		
	(ELINT)	X		
	IMINT (radar)	X		
Optical	IMINT	X		
	HUMINT (direct Observation)	X		X
Acoustic	ACINT	X		
Other	MASINT	X		
Human	HUMINT source	X	X	X
Cyber	computer		X	X

source : Publication interarmées PIA 02-200, *Instruction interarmées sur le renseignement d'intérêt militaire, Tome 1, Doctrine interarmées du renseignement*, 27 novembre 2003, p.1

Besides, OIF highlight an imbalance between ISR collection and analysis capabilities. Sensor performances and networking led to an increased number of targets of opportunity, compared to previous operations, and more broadly, to a growing mass of information. Combined with the rapid tempo of air ground operation, the capacity of information processing has been rapidly overwhelmed. LCDR Bradley of the Navy explains that: *“The immense number of targets, limited ISR assets, and insufficient personnel with BDA expertise, analytical tools, and sensor capabilities created a tremendous strain on the intelligence support architecture and prevented a thorough assessment of damage to the majority of targets”*⁶⁶.

1.4.6 – Information Operations

The main contribution of air and space power to the effects of counter-command and influence of the enemy and the people, that represent the purpose of the information operations, resides primarily in the informational and psychological effects of physical strikes.

One of the key adversary target systems, during OIF, OAF and OIF has been the C3 system either civilian or military, in a logic of functional decapitation of the decision makers. In all three cases, the strikes have succeeded in destroying the infrastructure of satellite telecommunication ground segment and radio networks (eg *Southern Focus*, operation prior to OIF during which the U.S. Air Force and British RAF have destroyed the Iraqi network of fiber-optic communication). However, in Iraq as in Serbia, the

⁶⁶ Carl M. Bradley, *Intelligence, Surveillance And Reconnaissance In Support Of Operation Iraqi Freedom: Challenges For Rapid Maneuvers And Joint C4isr Integration And Interoperability*, Naval War College, Newport RI, February 9 2004, p. 6.

effects remained limited: Saddam Hussein and Slobodan Milosevic retained the ability, in a degraded mode, to control their forces until the end of the engagement.

In addition, the air and space power, mostly American one, is likely to contribute to three types of information operations:

- ➔ The electronic warfare, with EA-6B and EF-18 aircrafts dedicated to jamming and SEAD, and EC-130H *Compass Call* communications jamming aircrafts operated by special forces ;
- ➔ Psychological operations with leaflets dropping devices and EC-130E *Commando Solo*;
- ➔ May be the computer warfare - Network Warfare Operations (NWO) in USAF terminology. The intrusion of the telecommunication systems might be indeed possible by inserting false emissions into the enemy wireless reception stations.

The design and coordination of these operations is fully joint, the force components executing the decisions planned by Info-Ops cells and taken by structures as IO Coordination Board. The planning also involves the strategic level. For instance PSYOP objectives and themes must be validated at the political level.

Information Operations and Iraqi Freedom.

A good example of information operations combining electronic warfare, computer and PSYOP, is given by OIF. To influence the Iraqi military, the Americans have destroyed or jammed much of the Iraqi C3 system and used remaining channels for PSYOP (eg sending mass mailing or calls on the cell phones of Iraqi officers) ⁶⁷. Electronic warfare and PSYOP were used to demoralize the Iraqi forces. 32 million leaflets were dropped in 158 sorties by B-52, F-16 and A-10, carrying 81 different messages. The EC-130E *Commando Solo* executed more than 600 hours of radio and television emissions, carrying 108 messages. The EA-6B and EC-130 *Compass Call* were also used in this purpose.

Nevertheless, most lessons learned⁶⁸ emphasize:

- ➔ The lack of coordination between these different areas of information operations;
- ➔ The lack of dedicated resources, particularly in air power ;
- ➔ The lack of conclusive effect, clearly identifiable, of such information operations and especially PSYOP. In conventional campaigns, these operations can mainly achieve tactical and immediate effect of demoralization when used in conjunction with interdiction strikes.

⁶⁷ Air Force C2ISR Center, *Operation Iraqi Freedom, Information Operations Lessons Learned First Look*, 23 July 2003, C-250-8.

⁶⁸ See Christopher Lamb, *Review of Psychological Lessons Learned from Recent Operational Experience*, National Defense University Press, Washington DC, September 2005 et Army lessons learned for OIF, Colonel Greer, colonel Fontenot & Lieutenant-Colonel Tohn, *On point, The US Army in Operation Iraqi Freedom*, First Naval Institute Press Edition, 2005, p. 419.

1.4.7 – The Mobility Function

It includes the in-flight refueling, strategic and tactical airlift, and medical evacuation.

The in-flight refueling is critical, whatever the nature of the engagement. The overwhelming share of the activity lies in the supply within the theater (Intratheater Refueling) for which the tankers operate permanently as flying gas stations. With air campaign emphasizing dynamic targeting missions, what involve to keep more aircraft in-flight longer, the need for air refueling is increasing. During *Desert Storm*, the 15 895 refueling sorties accounted for about 13% of total output, a share that has risen to more than 20% during OIF, during which 400 sorties were carried out daily.

The airlift is a key function of the joint operation. During *Desert Storm*, in ten days, from 18 to 28 January 1991, from 200 to 350 daily sorties of C-130 made in radio silence, allowed to project 14 000 men and around 10 000 tons of equipment XVIIIInd Corps on their position of attack near the Iraqi border.

The tactical airlift and the air mobility are a vital function in the new concepts of operations in non-contiguous areas currently favored by the Army and Marines. Recent Navy/Marine Corps concept of Seabasing and Army concept of operational maneuver of the Future Force⁶⁹ rely heavily on the “Mounted Vertical Maneuver”, which envisages air assault, on nearly all desired points of need on the theater, of mechanized combined forces able to maneuver independently in non-continuous areas. A key platform to deploy and support seamlessly these units is a heavy vertical take-off and landing airlift aircraft. This capability is currently offered by cargo helicopters. Nevertheless, their limitations in terms of payload – notably the inability to board 20-25 tons armored vehicles – as well as the lack of flexibility of tactical aircrafts, which require a few hundred meters-long minimum operating strip – led the Army to express the requirement for a new heavy tilt-rotor aircraft, under USAF-led Joint Future Theater Lift program (formerly Joint Heavy Lift). But the project is on the edge of the current technological capacity.

Another component of these concepts are the “Distributed Operations”⁷⁰ based on autonomous operations of a network of small units, separated by several tens of km, and nevertheless capable of coordinate and direct fire on the adversary. The Chindits during World War II and the French “hunting commandos” in Algeria are historically recorded examples of successful distributed operations. More recently, the operations of the two Combined Joint Special Operations Task Forces North & West in *Iraqi Freedom*, tended to this types of engagement. In such operations, when the forces cannot be inserted through an adjacent border, their deployment and support are impossible by land lines of communication. Such concepts require therefore new airlift capabilities. New assets such as unmanned aerial vehicles “mules” are under study in the Marine Corps to supply distributed sections.⁷¹

⁶⁹ TRADOC Pamphlet 525-3-1, *The United States Army’s Operating Concept for Operational Maneuver, 2015 – 2024*, Version 1.0, 2 October 2006, www.tradoc.army.mil/tpubs/pams/p525-3-1.pdf

⁷⁰ Headquarters, US Marine Corps, *A Concept for Distributed Operations*, 25 August 2005.

⁷¹ J.C. Sommerer & alii, *Distributed Operations: Communications, Logistics, Education & Training*, U.S. Naval Research Advisory Committee (NRAC) Panel on Marine Corps Distributed Operations, juillet 2006,

But the most challenging mobility requirement remains the rapid distant force projection on the theater, implying an important in-flight refueling and a significant strategic airlift including airborne assault.

1.4.8 – Space Support

Conventional campaigns are obviously the largest consumers of Space Force Enhancement capacity, which ensure coherence of the force.

First, in ISR, services and agencies deployed for several years means allowing theater HQs and units to access directly to strategic intelligence data. The multiple American TENCAP (Tactical Exploitation of National Capabilities) programs and the French STT, *stations de transmissions de théâtre*, offer two examples of this trend.

In the field of SATCOM, during OIF, the available bandwidth was expanded from 113 Mb / sec to 783 Mb / sec, multiplying more than ten times the capacity that was available in ODS⁷². However, it was still insufficient to match the needs, particularly in communications satellite. The consequence was delayed communication between the CAOC and aircraft hindering the capacity to deal with several objectives⁷³. These needs have increased largely as a result of two main factors associated with network operations. First, U.S. forces generalize past ten years the "reach-back," the solicitation of the analysis and processing centers in the United States to avoid their deployment on the theater. For example, the IMINT collected by the *Global Hawk* or the U-2 is produced entirely at Beale AFB in California and then disseminated back to the CAOC. Secondly, on the theater, the bandwidth requirements are driven by the widespread dissemination of imagery and video. The transmission of videos taken by unmanned aerial vehicles to a growing number of CP lead to a rapid expansion of the requirement, even if this operational need is yet to be proved and the staff to exploit it may not be available. This is, according to several studies, the main source of likely shortage of future communication systems of the Army, the WIN-T⁷⁴.

We won't develop further the importance of the GPS constellation for navigation and guidance of a growing proportion of guided munitions, a real critical infrastructure of American power and hence of all the coalitions it has to lead.

The improvement of SFE has resulted in better integration of the C² of air and space operations at least in the U.S. forces. For the first time in OIF, the U.S. made SPACECOM daily Space Tasking Order (STO), developed in the wake of the ATO, to adapt the space support to operations. The STO, now developed by STRATCOM, collates and prioritizes the needs of all the theaters and then allocates capabilities in line with operational requirements. It can manage for example the use of SATCOM and the

⁷² CENTAF, Assessment and Analysis Division, *Operation IRAQI FREEDOM, By the Numbers*, April 30 2003.

⁷³ Staff Sgt. Jason L. Haag, "OIF veterans discuss lessons", *Air Force Print News*, July 31 2003.

⁷⁴ Congresssional Budget Office Study, *The Army's Bandwidth Bottleneck*, August 2003, www.cbo.gov, & Leland Joe, Isaac Porche, *Future Army Bandwidth Needs and Capabilities*, Rand Corporation, Aroyo Center, MG-156, 2004.

GPS constellation. In this case, it intends to maximize the four-angle signal during key periods of precision strikes⁷⁵.

2 – Counterinsurgency Campaign

While conventional engagements represent the bulk of the use of aerospace power by Western governments since the end of the era of de-colonization, the armed struggle against an insurgency is quite common to other governments: the Soviet Union in Afghanistan, South Africa in Angola, Israel in Lebanon and in the occupied territories, the authorities of Sri Lanka against Tamils, Filipinos against Abu Sayaff, Colombians against the FARC. In Africa, internal rebellions supported or not by outside countries are the primary concerns of governments. Besides, because of the recent or current campaigns in Afghanistan, Iraq, Lebanon or in the territories occupied by Israel, the last developments in the use of aerospace power concerned more these kind of engagements, rather than conventional operations.

Regarding the employment of aerospace power, two very different situations should be distinguished:

- The first involves the engagement of a regular armed force under the command of a national government facing a armed rebellion;
- The second involves a force of a third country engaged in a counterinsurgency campaign along with a government ally, or promoting an internal uprising against a hostile government.

The analysis will be conducted in three stages: the definition of insurgency and the contribution of military to a counterinsurgency strategy; the description of the evolution of American aerospace power in this context; and the analysis of generic options to prevent the militarization of insurgency or to demilitarize proved insurgency.

2.1 – Insurgency / Counterinsurgency: Definitions and Characteristics

2.1.1 – The Insurgency: An armed Rebellion Against an Incumbent Government

The insurgency is a complex social and political mechanism described in many different ways. Considering the recent experience gained by the Americans and the British in the field, the analysis is based on the U.S. and UK definitions and assumptions on insurgency movements.

The British army provides this definition of an insurgency: *“The actions of a minority group within a state who are intent on forcing political change by means of a mixture of subversion, propaganda and military pressure, aiming to persuade or intimidate the broad mass of people to accept such a change”*⁷⁶.

⁷⁵ Cf. par exemple, Col Tony Williams, AFSPC/XOZ, *Command and Control of Space Forces - A Weapon System Approach*, presentation à la National Defense Industry Association, August 25 2005.

⁷⁶ Army Code No 71596, *Counterinsurgency Operations*, Part 1, *Concept and practice of insurgency*, DGD&D, 1995, p. 1.1.

The latest official U.S. definitions describe the insurgency as:

- ➔ *“An organized, protracted politico-military struggle designed to weaken the control and legitimacy of an established government, occupying power, or other political authority while increasing insurgent control”⁷⁷.*
- ➔ *“Any attempt by a dissident element to organize and incite the population of a country into forcibly overthrowing its existing government”⁷⁸.*
- ➔ *“Protracted political-military activity directed toward completely or partially controlling the resources of a country through the use of irregular military forces and illegal political organizations. Insurgent activity—including guerrilla warfare, terrorism, and political mobilization, for example, propaganda, recruitment, front and covert party organization, and international activity—is designed to weaken government control and legitimacy while increasing insurgent control and legitimacy”.⁷⁹*

Therefore four characteristics of an insurgency can be inferred from these definitions:

- ➔ An armed struggle to overthrow a government in place;
- ➔ Backed by a popular revolt of long duration;
- ➔ Involving the primacy of the political dimension of the struggle for the conquest of power and actions of subversion of a political nature;
- ➔ Supported by irregular forces or methods of warfare.

2.1.2 – Counterinsurgency: A Governmental Strategy to Eradicate People Dissatisfaction

The UK approach is based on the idea that the counterinsurgency is a form of political struggle combining six key principles:

- ➔ Supremacy of civilian authority and political goals in the conduct of military action;
- ➔ Extensive comprehensive “whole-of-government” coordination;
- ➔ Priority to intelligence and information;
- ➔ Separation of rebels from their support;
- ➔ Neutralization of the rebels;
- ➔ Protracted counterinsurgency plan aimed to deprive the popular discontent serving root causes of the insurgency.

In the UK approach, unity of command in the campaign is a crucial point. The guidance and the strategic plan are produced by civilians and enforced under the authority of a government representative in the area.

However, the conduct of operations depends on the commander in chief who controls the entire military and security forces as well as civilian programs designed to

⁷⁷ FM 3-24/ MCWP 3-33.5, *Counterinsurgency*, Department of the Army, Marine Corps Combat Development Command, Washington (D.C.), December 2006.

⁷⁸ MCWP 3-33.5, *Counterinsurgency operations*, US Marine Corps, October 2004.

⁷⁹ Central Intelligence Agency, *Guide to the Analysis of Insurgency*.

implement political, security and social reforms. These reforms are deemed necessary to exhaust the reasons for popular dissatisfaction feeding the armed rebellion.

The U.S. Military defines counterinsurgency as “*Those military, paramilitary, political, economic, psychological, and civic actions taken by a government to defeat insurgency*”⁸⁰ It is at the intersection of two main operational missions:

- ➔ The Irregular Warfare, (IW). IW is defined as “*a violent struggle among state and non-state actors for legitimacy and influence over the relevant populations*”⁸¹ The destruction of the enemy forces is considered as a set of activities supporting this main axis ;
- ➔ The Support to Stabilization, Transition and Reconstruction, (SSTR). The development of SSTR has proved necessary in the aftermath of major combat operations in order to cope with events in Afghanistan and Iraq. The National Security Presidential Directive (NSPD) 44⁸², as published on 7 December 2005 in an unclassified version, deals with the whole-of-government management in the field of reconstruction and stabilization and specifies the responsibilities of the Department of State and Defense. At the DoD level, the DoD Directive DODD 3000.05⁸³, published earlier in November 2005 on military contributions to those operations, states that the U.S. armed forces must be prepared to conduct or support these operations and grant them the same priority level as for combat operations.

Both missions are the subject of a *Joint Operating Concepts*, describing the characteristics of these operational missions in the mid-term:

- ➔ JOC SSTRO 2.0⁸⁴, developed by the US Joint Forces Command, takes into account the leading role and intellectual concepts of the civilian actors of the development community, notably USAID and the State Department;
- ➔ And the JOC IW developed by the US Special Operations Command and the Marine Corps.

The British and American approaches focus on the coordination of all civilian and military actions of a nation in the framework of a grand strategy dealing with stabilization and reconstruction efforts, as main tools for thwarting with an armed insurgency.

⁸⁰ JP-1.02, *DoD Dictionary of Military and Associated Terms*, April 2001, Amended January 2003, p. 27.

⁸¹ United States Special Operations Command, United States Marine Corps, *Irregular Warfare (IW) Joint Operating Concept (JOC)*, version 1.0, February 2007, www.dtic.mil/futurejointwarfare/concepts/iw_joc1_0.pdf, p.1

⁸² *National Security Presidential Directive 44: Management of Interagency Efforts Concerning Reconstruction and Stabilization*, 7 décembre 2005, accessible à <http://www.fas.org/irp/offdocs/nspd/nspd-44.html>

⁸³ Department of Defense Directive 3000.05, *Military Support to Stability, Security, Transition and Reconstruction (SSTR) Operations*, 28 novembre 2005, accessible à <http://www.dtic.mil/whs/directives/corres/pdf/300005p.pdf>

⁸⁴ Joint Forces Command, *Military Support to Stabilization, Security, Transition and Reconstruction Operations*, Joint Operating Concept, version 2.0, December 2006, www.dtic.mil/futurejointwarfare/concepts/sstro_joc_v20.doc

2.2 – USAF Doctrine for Irregular Warfare

Irregular warfare engagements are different from conventional operations. Aerospace power does not issue the same effects. The USAF, under the pressure of the circumstances, drafted up quickly a doctrine in 2007⁸⁵ for dealing with this kind of engagement. Broadly speaking, in the case of counterinsurgency, the role of air and space power is to support the force and to reduce significantly the military options left to the insurgents

The following table summarizes the key differences regarding the use of air and space power in conventional and irregular warfare.

Tableau n°1 : AIR AND SPACE POWER IN...

CONVENTIONAL OPERATIONS	IRREGULAR WARFARE
Decisive effects	Support to other components of the force
Rapid victory	Protracted conflict
Main effects obtained through the targeting of the enemy forces and strategic systems	Effects supporting the gain of the support of the population
ISR capabilities focused on the targeting and the damage assessment of the enemy forces and systems	ISR capabilities partially used to support the development of the knowledge of the cultural environment

Source : AFDD 2-3, Irregular Warfare, chapter One.

2.2.1 – *Key Activities of Irregular Warfare: A USAF Perspective*

For the USAF doctrine, IW encompasses five kinds of key activities for the air and space power.

- ➔ **Counter-terrorism** which consists in targeting the armed groups where they are, either directly or indirectly by application of all of aerospace effects against a hostile state sponsoring terrorists or supporting a state unable to eradicate them;
- ➔ **Shaping and deterring** through the use of ISR capabilities, information operations, and humanitarian assistance. The aim is to prevent the emergence and development of hostile armed groups in the region and preparing for the response, in the best conditions;
- ➔ **Counterinsurgency** which corresponds to the direct engagement of U.S. forces against an armed rebellion, in the absence of a host government in a position to do so;
- ➔ **Support to Counterinsurgency** which is an indirect strategy for the benefit of a host government that bears the essential of the armed struggle. These supporting activities to curb the insurgency may be military, paramilitary, political, economic,

⁸⁵ AFDD 2-3, *Irregular Warfare*, U.S. Air Force, August 2007, www.dtic.mil/doctrine/service_publications_usairforce_pubs.htm, p 2.

psychological and civil. They include education, training, sale and maintenance of supplies and equipment; and finally

- ➔ **Support to Insurgency** against a government hostile to the United States or against a foreign occupation force of a friendly country through the training and the support of armed groups.

Every option relies on a different combination of operational functions of the aerospace power or, in the case of support to the counterinsurgency, on the development of tailored capabilities to a partner government.

2.2.2 – Air and Space Power Main Contribution: Reducing the Military Options Left to the Insurgents

The use of air and space power in situations of counterinsurgency is optimized when the insurgents are operating paramilitary courses of action. In this case, all the operational functions are required. The actions are decisive when the opponent organized in a strong geographic footprint offer a significant number of high-value targets: bases or sanctuaries, fielded units, combat platforms (light armored vehicles or heavy weapons).

American designers of aerospace power foresee five major contributions of the third dimension to the direct or indirect fight against an insurgency.

- 1 – **Providing security to the ground component** in reducing the footprint of the ground counterinsurgency force and then decreasing the level of tension favorable to the development of insurgency. Besides, by providing accurate firepower, maneuverability and situational awareness to regular units, air and space power can balance insurgents' advantages, by enabling rapid maneuver throughout the theater and avoiding tactical collapse of small overwhelmed units.
- 2 – **Help alleviating root causes of insurgency** by sustaining the legitimacy of the incumbent government through airlifting humanitarian assistance, contribution to essential services provided to the population and support to government information operations (PSYOP campaign);
- 3 – **Limiting an adversary's conventional options and flexibility** in preventing paramilitary units to shift to conventional courses of action by monitoring wide areas and attacking massing forces;
- 4 – **Disrupting enemy movement** by targeting enemy flow of material and personnel coming from outside the country;
- 5 – **Targeting insurgent leaders and active supporters** with the Time-Sensitive-Targeting lethal and non-lethal capabilities.

As stated by the USAF, the characteristics of lethality, precision, flexibility and ubiquity of the air and space power in a conventional context are confirmed against a guerrilla-like insurgency, operating decentralized courses of action on very short notice. Air and space power is therefore leveraging the efficiency and effectiveness of the ground forces and political authorities.

2.3 – Air and Space Power Role in Counterinsurgency Strategic Options

Fighting an armed insurgency is a very demanding task for a local government. It is even more difficult for a force operating in a foreign country to assist the local government or to occupy the country. Directed at irregular enemies, in the midst of civilian populations, the use of air and space power raises the sensitive issue of collateral damages to properties and persons and create conditions for a political dilemma of legitimacy for the incumbent government. However, History offers interesting examples of selective and successful use of air capabilities in the framework of a coherent governmental policy.

2.7.1 – Insurgents Discernible Geographic Footprint: The Threshold of Operational Air and Space Power Efficiency

For western countries, air and space power became the key instrument for coercive strategy and diplomacy, due to an optimum “operational efficiency”. By “operational efficiency” we mean: *“the ratio between financial, human and capabilities effort used to reach a goal and the results at the end of the engagement”*.

The level of operational efficiency is linked to the amount of enemy high-value targets (HVT)⁸⁶ that can be identified as high pay-off targets (HPT)⁸⁷ for friendly commanders at each phase of the campaign plan. For air and space power, the identification of those high pay-off targets depends on the degree of visibility and vulnerability of the HVTs to the action through the third dimension. More HVTs falls into that category, more air and space power will be operationally efficient.

From a strategic perspective, only complex and sophisticated human organizations relying on control of territories and populations for developing their capabilities may offer a discernable geographic footprint. States are the most common strategic entities displaying a large number of HVTs, including networks of infrastructure systems and institutions vital to secure, control, manage and provide services to people and to ensure the cohesion of society. Airpower has been created and developed to cope with this large amount of potential targets in wartime. Nevertheless, other types of human non-state organizations are operating violent courses of action without offering a discernable geographical footprint. Using the classification of asymmetric entities exposed in the first part of this report, the rationale for the degradation of operational efficiency of air and space power becomes obvious when confronting this non-state entities.

Counter-State entities tend to control a territory and a population for gathering resources, building up strong paramilitary capabilities and securing the political legitimacy of the rebel organization. Maintaining an unrestrained local domination is a prerequisite to the success of the rebellion. Therefore counter-state organization offers,

⁸⁶ The High Value Target (HVT) is defined as: «A target the enemy commander requires for the successful completion of the mission. The loss of high-value targets would be expected to seriously degrade important enemy functions throughout the friendly commander's area of interest». JP. 1-02, Department of Defense Dictionary of Military and Associated Terms, as amended as 9 January 2003, p. 236.

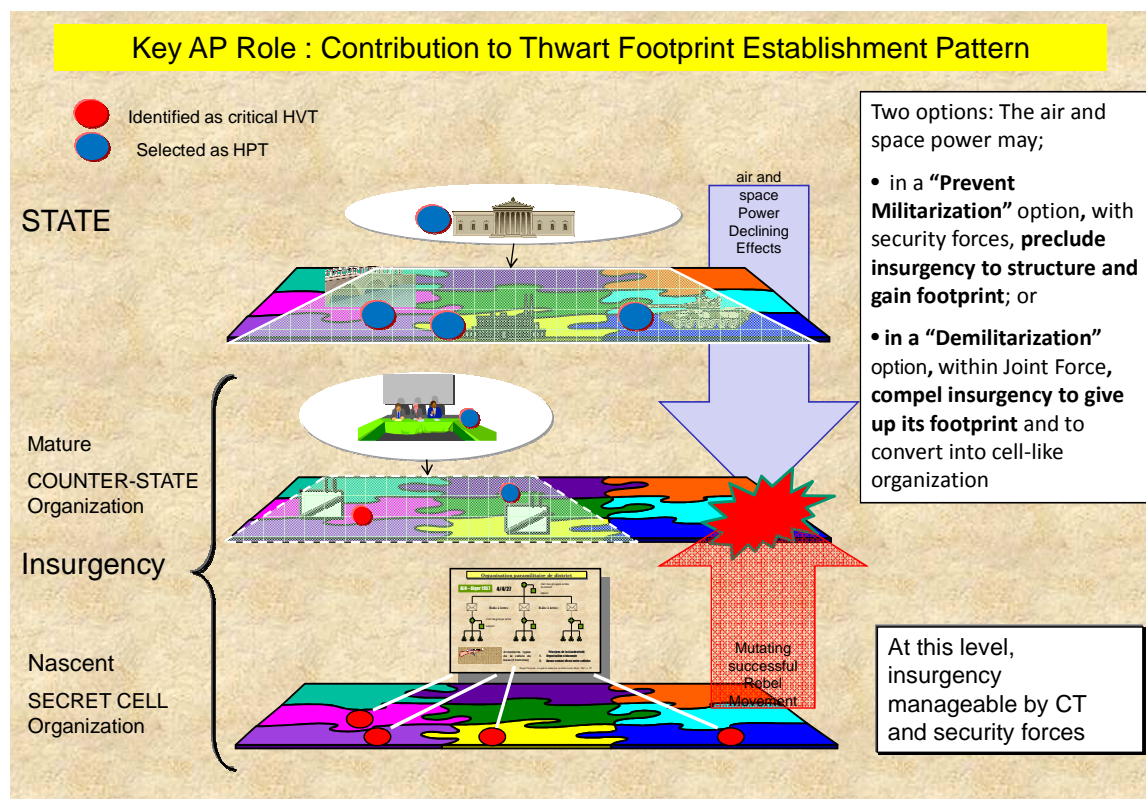
⁸⁷ The High Pay-off Target (HPT) is defined as: «A target whose loss to the enemy will significantly contribute to the success of the friendly course of action. High-payoff targets are those high-value targets, identified through wargaming, which must be acquired and successfully attacked for the success of the friendly commander's mission». JP. 1-02, Department of Defense Dictionary of Military and Associated Terms, as amended as 9 January 2003, p. 236.

when mature, a set of HVTs encompassing paramilitary units and associated support (training and logistics facilities), lines of communications, staggering areas and sanctuaries. Nevertheless, operating air operations remains a difficult exercise considering the operational countermeasures adopted by irregular paramilitary organizations:

- ➔ The concealment, camouflage and deception measures to reduce the visibility of the facilities, as demonstrated by the Viet-Cong during Vietnam War or Hezbollah in the 2006 war in Lebanon. Key facilities are often located in or in close vicinity to hospitals, religious sites or densely populated areas for preventing strikes or causing mass casualties if lethally attacked.
- ➔ Sanctuaries location in neighboring states provides also the diplomatic protection against direct attacks by “neutral” or hostile governments eager to assist the rebellion against the incumbent regime.
- ➔ The pattern of paramilitary operations encompassing a set of decentralized, hit-and-run, all-weather, day and night courses of action contribute to significantly diminish the exposition to the blows of airpower. In that matter, a key element for tactical success is the ability of friendly ground forces to deploy and operate timely in critical areas, forcing paramilitary units to concentrate and fight, making them vulnerable to air strikes.

A secret-cell organization uses a different pattern of development. The mobilization of sympathizers and resources does not require the control of a large number of people, but instead a low profile to avoid any premature interference of security service or police forces. Therefore, it does not present any elements of geographical footprint that would be discernible by the air and space power.

The territorial control of **organized crime organizations** is somewhat different. “Territories” are rather civilian areas of operations for illegal activities. These entities melt down with the civilian environment within which they thrive. At the exception of specific areas such as opium poppy or coca fields, organized crime assets cannot be easily spotted or identified by military intelligence.



Notwithstanding the aforementioned negative effects, air and space power remains – when appropriately operated - a major challenge for the dynamics of developing insurgencies. Indeed, secret-cell organizations (terrorists) never succeed on their own to topple an incumbent government. Therefore, when aiming at gaining political power, a nascent insurgency needs to transform into a mature movement in order to establish and maintain a territorial footprint. According to the Maoist “People War” model inherited from the Chinese revolution experience, successful insurgents should rely on this transformation process to win decisively against a weakened leadership system. FARC in Columbia as well as LTTE in Sri-lanka, have recently experienced the lethal consequences for their survivability of the loss of a territorial footprint.

But as they are structuring, from a pure military perspective, those entities become more and more vulnerable to regular forces including airpower (if the government keep moral and material resources to create a credible opposition). These organizations are confronted to a dilemma: either to keep low-profile small groups size and never to be in position to prevail politically; or to transform into a more sophisticated organization and to take the risk of being dismantled by conventional operations. To this regard, air and space power plays a key role to deny the “crystallization” of the military power of these entities.

Taking this fact into account, two strategic options are left to a government facing an armed rebellion depending on the maturity of the insurgency.

2.3.1 – Option 1: Preventing the Militarization of a Nascent Insurgency

The first option is to prevent **the militarization of the insurgency**. It involves a rapid awareness by the authorities that civil strife is not only the result of a marginal bunch of criminals or terrorists, but revealed a deep malaise in society that could degenerate into armed conflict or civil war.

At this stage, the types of collective violence faced by the government in place are riots, civil disobedience, urban terrorism and loosely organized paramilitary activities conducted by armed gangs or unprepared local militias.

As part of a comprehensive strategy to answer the causes of people discontent, security forces are in the front line to maintain or restore law and order, eventually backed by regular armed forces. The essential tasks consist in monitoring geographic areas (borders, urban areas or remote rural areas), controlling the national territory to prevent free movements of armed groups or weapons, seeking out and arrest individuals or groups to trial them.

In a context of poorly organized insurgency air and space power can provide specifically tailored capabilities to support security forces and efforts of civilian institutions. ISR (IMINT-SIGINT) could make the difference for border or area monitoring. Transport capability could also be available for counter-terrorism special forces and police, for increasing the freedom of movement of VIPs and government officials implementing the civilian measures of the counterinsurgency campaign (humanitarian assistance, electoral materials ...). Helicopters, unmanned aerial vehicles and transport aircraft are therefore critical assets and should be used in combination with Army, Air Force and Special Forces capabilities (surveillance, reconnaissance, psychological operations). The air force is mainly responsible for air security and air police missions, including the protection of civilian airport and military air bases.

The overall mission of air and space power contributes to the enhancement of the governmental territorial control rendering difficult an effective militarization of the insurgency.

2.3.2 – Option 2: Demilitarizing a Mature Insurgency through combat operations

However, in the real world, the first option is rarely adopted. An incumbent government is almost always reluctant to admit officially the reality of an armed rebellion. Insurgents' activities are not detected as such and look like criminal activities at best. Most often, national authorities deny the reality either by ignorance or by political miscalculation. Therefore, appropriate counter measures are not taken in due time, allowing the rebels to grow in size and expertise. Once militarized, the rebellion movements have already the capacity to oppose security forces and enjoy safe havens and sanctuaries in "no-go zones".

The regime faces then a lethal threat and has to commit all available forces and resources to wage a "total war" against insurgents. Indeed the outcome of the armed conflict will be either the annihilation of rebel organizations or the overthrow of the incumbent government.

The nature of the threats has also changed. National Authorities do not oppose only terrorists or loosely organized armed groups, but complex and redundant entities,

powerful enough to operate in entire regions with fielded paramilitary units and equipment within the framework of irregular campaigns.

From a governmental perspective, maintaining a credible legitimacy to public opinion and international community becomes the strategic aim. To achieve it, the operational aim consists in regaining by force the lost territories. At the tactical level, the destruction of paramilitary capabilities of the insurgents is the prerequisite. The demilitarization of rebels is a mission given to joint forces. Once insurgency is demilitarized, either survivors become vulnerable to the action of the security service and police, or they flee abroad to recover, or they choose to negotiate a peace agreement.

Air and space power is then engaged with all of its operational functions to support the land component and Special Forces. More insurgents offer geographic footprint and high value targets identified by military intelligence, better is the effectiveness of the aerospace instrument.

This support will be provided initially in the form of a close air support of ground troops and air interdiction campaigns on lines of communication between the areas of engagement of insurgents and sanctuaries. Other key capabilities include the intra-theater air mobility, which enhances maneuver and logistics support of the ground forces and the contribution to the information operations. As an extension of the ground maneuver, the engagement of air assets takes advantage of the windows of vulnerability of the insurgents, as they face a well-known tactical dilemma: Engaged on the ground, they must concentrate to resist and then display high pay-off targets for artillery and aircraft; Otherwise, they should disperse, lose all operational coherence and give up strategic initiative.

The imbalance of power between the regular forces and insurgents allows a discriminate use of force. This is enabled by surveillance and reconnaissance capabilities ensured by the combination of air and ground sensors (including light infantry or Special Forces team) establishing a network of observers on sensitive areas. It is then ensured by strikes on hostile targets with guided munitions to limit the collateral damage. A discriminate engagement encompasses an all set of courses of action with airborne or airmobile units and not only air strikes. Finally, a decentralized C² architecture between components of force is organized at the lowest possible tactical level (battalion, company and special team) to conduct operations smoothly and timely.

In this option of counterinsurgency, direct action capabilities provided by the third dimension require platforms capable of endurance, carrying a variety of precision or saturation weapons, to meet all kind of predictable targets on the ground and to match the tactical evolution. Availability of transport capability is also a decisive advantage.

Finally, the air and space power instrument allows rapid changes in military layout, over large geographical areas. It helps to increase significantly the margin of initiative of the joint force and accelerates the attrition of irregular paramilitary units, while limiting the losses of friendly forces.

The military success in this context is acquired once the insurgent organization is demilitarized. It is the role of political authorities to ensure that the benefits thus obtained can be transformed into political solution through negotiation with the insurgents or elimination of their organization. Otherwise, the insurgents are changing

courses of action at least temporarily (use of terrorism), until they are able to rebuild their paramilitary capabilities.

2.4 – The Dilemma of Tactical Strikes in Counterinsurgency

The issue of air strikes - or heavy ammunition - in counterinsurgency environment is still the source of a dilemma of legitimacy for the government who takes this responsibility.

From the campaigns of colonial police on Iraqi borders or in the Rif at the beginning of last century, to the air operations over Afghanistan today, the damage caused by heavy weapons and aircraft raises emotions and anger in the local population and international public opinion. The political and military authorities in charge of these strikes are still facing the same dilemma:

- ➔ Increase tactical effectiveness by using massive firepower to defeat irregular units in the field and support the ground maneuver;
- ➔ At the cost of a higher risk of civilian casualties and recruitment of dissatisfied victims into the ranks of the armed insurgency - At least a greater sympathy for the cause of the insurgency.

2.4.1 – Options for Using Combat Air Power: Retaliation, Attrition or interdiction of Rebel Paramilitary Organization

A government seeking to defeat an insurgent army can use the combat aerospace power according to three distinct options.

A terror option against the population deemed to be supporting the insurgent cause. Air strikes aim knowingly civilians as punishment for their support and demonstrate the unquestionable determination of Authorities to prevail over the insurgents, whatever the cost. War of the Rif, in the 1920s portrays a common feature of the colonial era solutions of the time with deliberate bombardments of rebel villages. Similarly, the attack against the city of Hama in Syria by Damascus forces in February 1982 put an end to the Muslim Brotherhood uprising in the country.

A sub-variant is to deteriorate the environment which feeds the insurgency. The *Ranch Hand* operations spreading dioxin in South Vietnam were intended to defoliate large areas of woodland to help the detection of the Viet Cong buried infrastructures. They also poisoned the environment, making it unsuitable for plants life, animals or humans alike. The Soviets, during the invasion of Afghanistan launched extensive campaigns of bombing and mining of rural areas in order to destroy the villages and make fields and meadows unfit to exploitation in order to cut the Afghan resistance its sources of food and shelter in the population. The results were limited. Much of the civilian population fled to Pakistan and became an available pool of recruits for the resistance.

Morally condemned and politically risky, given the negative reaction of international opinion, this option is less used than in the past, but still left to authoritarian or endangered governments.

The second **option** is to **weaken the paramilitary capacity of the rebels**. It is part of a joint strategy of attrition, by striking insurgent units engaged and uncovered logistical infrastructure. The close air support is the most effective direct activity, because it

implies a positive identification of ground targets by tactical air controllers who can assess the risks of collateral damages. This option is also opened to foreign air forces assisting a local government in counterinsurgency activities.

The third **option** is a strategic form of **interdiction campaign** aiming at restricting the freedom of movement of insurgents by targeting leaders, activists and their resources. However, these are “elusive” targets highly difficult to locate and identify (light vehicles, small groups, even individuals). This option requires to master the full deployment of a *Time Critical Targeting* (TCT) or *Time Sensitive Targeting* (TST) architecture with a dense network of monitoring sensors, a specific C² arrangement, a set of platforms capable of shooting a wide variety of ammunition for long loitering missions. This option is available to a very few number of air forces in the world (USA, Israel, NATO air component operating with U.S. C4ISR architecture).

2.4.2 – *An Increased Dilemma in Urban Areas*

The dilemma created by the air strikes is increased in urban environment so common to all contemporary conflicts. Estimates of international organizations, such as the World Bank, highlight an urbanization trend of populations (In the year 2015, 1 million inhabitants in 516 cities, 8 millions in 33 cities, including 27 in the Third World)⁸⁸.

Obviously, conducting military operations in build-up areas is extremely difficult and risky due to the likely occurrence of large scale casualties and damages inflicted to people and properties. In “asymmetric” conflicts, urban areas are conceived as a power equalizer to deny the technological advantages of regular armed forces, as depicted in the following table.

Joint Conventional Warfighting	Impact of Urban Areas Environment
1. <i>Information Superiority</i>	1. <i>Thickening of the “fog of war”</i>
<ul style="list-style-type: none"> • Situational awareness • Networked sensors, C² and effectors. • Effects-based planning and conduct 	<ul style="list-style-type: none"> • Compartmented environment • Easy measures of camouflage, concealment and deception (CCD) • Thwart to systemic analysis if the target sets
2. <i>Quality of strike and maneuver</i>	2. <i>Reduction of space and precision</i>
<ul style="list-style-type: none"> • Seamless coordinated maneuver from the strategic, to the operational to the tactical level • Precision strike • Avoidance of direct contacts with enemy to reduce casualties 	<ul style="list-style-type: none"> • Compartmented multi-level environment, fragmenting maneuvers • Measures of CCD • Need for direct engagement of adversary

⁸⁸ *World Resources 1996-97, A Guide to the Global Environment*, p. 127.

3. <i>Limitation to collateral damage</i>	3. <i>Limitation to desired effects achievement</i>
<ul style="list-style-type: none"> • Joint, interagency and combined synergy of EBAO • Limitation of lethal effects • Supporting influence operations (low efficiency) 	<ul style="list-style-type: none"> • Undesired Effects of collateral casualties among civilian (explosion of weapon caches, impossible access to healthcare...) • Mixing of civilian population and irregular combatants • Efficient adversary victimization strategy

In conclusion, the urban environment makes it very difficult to identify targets of military value among civilians. It also requires weapons with reduced lethal effects to respect the principle of proportionality of air strikes. Discrimination of targets and proportional courses of action are two constraints imposed on armed forces and governments by the contemporary international legal systems. Ignoring them deliberately or implementing them imperfectly costs a high political price.

2.4.3 – The Quest for Discriminate Strikes: Technical Solutions

The traditional use of aviation on urban centers, except in the case of strategic bombing, is designed to provide the ground troops with a “super-close” artillery support. It is a response to a well-known tactical problem. In a classic joint military engagement, the ground troops moving into build-up areas are approaching from expected directions by the enemy. They soon are trapped in a network of “fire pockets”, obstacles, mines and strong points. The tactical situation becomes quickly unmanageable, due to the difficult coordination between dozens of micro-engagements over distances of several hundred yards. The air support is called upon for reconnaissance and destruction of strong points. Of course, the unleashed firepower inflicts heavy damages to entire blocks in the city and kills many non evacuated civilians. Finally, the supported friendly forces experience a tougher mission, having to move into the heavily defended rubbles of Stalingrad, Hue or Grozny.

Logically, airmen use to consider the urban environment into five operational dimensions⁸⁹:

- ➔ The aerospace dimension itself by which transit the emissions, aircraft and munitions;
- ➔ The urban air dimension, formed by the heights of buildings, where it is possible to maneuver, to cover, to hide;
- ➔ The ground dimension formed by networks of roads and the first level of buildings;
- ➔ The underground dimension, including networks of sewage, water supply, telecommunications, power, cellars, car parks and shelters;

⁸⁹ Capt. Troy S. Thomas (USAF), “Slumlords; Aerospace Power in Urban Fights”, *Aerospace Power Journal*, Spring 2002, pp. 59-68.

- ➔ Finally, the information dimension which includes the overall activities of electronic warfare, communication and psychological operations.

However, the urban architectures impose constraints on air operations. Indeed, the buildings constitute masks creating blind spots for monitoring and engage targets on the ground and at lower levels. Targets on the ground have therefore a short window of vulnerability, appearing in the line of sight of air weapon systems only a few tens of seconds.

The lessons learned from many air campaigns in urban areas⁹⁰ highlighted three challenges to the effectiveness of attacks, as demonstrated by American attempt to take over city of Al-Fallujah in November 2004:

- ➔ Identification of the targets;
- ➔ The power of the ammunition fired at the targets: If too powerful, unnecessary damages are inflicted; Reduced lethal effects can even not hit the target;
- ➔ The constraints imposed on strike authorizations due to the close proximity of friendly forces or civilian population.

The technical solutions adopted to mitigate the impact of the political dilemma rely on an intensive use of precision-guided weapons linked to network of human and electronic sensors on the ground for target identification and collateral damage assessment. Overcoming the challenges of elusive targets in urban environment also involves a lasting effort of careful preparation and planning– including a detailed intelligence preparation of the battlespace – and a set of capabilities:

- ➔ Air platforms (UAVs, planes, helicopters) ensure the monitoring of urban and suburban areas and relay transmissions in the shadows;
- ➔ Teams of tactical air controllers, accompanied by other special forces and light infantry, use more or less integrated systems combining laser illumination, imagery and data-link to designate target and assess battle damages;
- ➔ A joint C3 architecture allows the networked users to share a common visualization of the overall tactical situation;
- ➔ Common databases, geo-referenced grid and mapping are used to direct and guide fires and support; and
- ➔ all force components train and operate according to joint concepts and doctrines for intervention in build-up areas.

Concerning the ammunition used in urban CAS, lessons learned stress the need to get different types of weapons, in order to combine their effects. The Americans use laser or GPS-guided bombs with small warhead (LJDAM GBU-38 / B and GBU-39 *Small Diameter Bomb* - SDB). The British tested inert warheads. These weapons have limited blast and seem to match the sought effects in modern buildings. Another lesson learned from different urban engagements (Lebanon, Gaza strip...) is the poor result obtained by air-launched anti-tank missiles. Masonry is usually penetrated, but the blast effect is almost inexistent. It is therefore difficult to eliminate snipers. In contrast, these munitions are most effective when directed at elusive ground targets. 20 mm. to 35 mm.

⁹⁰ Alan J. Vick, John Stillion, *Aerospace Operations in Urban Environments: Exploring New Concepts*, Rand MR-1187, 2002, 314 p.

automatic guns produced also lethal effects against elusive targets without significant collateral damage. The “magic bullet” approach never works in urban fighting. Better results are provided by the right combination of air and ground munitions and assets depending on the local circumstances.

A good example of using air fires in urban areas : The Az-Kubaizi Mosque – Fallujah – 7 April 2004⁹¹.

A platoon of Marines was attacked by snipers and RPG fire from inside the mosque. Marines on the ground can not see the attackers, hidden by walls. Direct fire artillery are prohibited because of the rules of engagement. An initial request for fire support led to the firing of two laser guided bombs of 225 kg against the wall outside the mosque. Once the dust fallout, the Marines identify blows departures from the minaret and the top floor of the building. A second request for fire support involves an attack helicopter AH-1W Cobra equipped with antitank missiles AGM 114 - Hellfire. Two missiles are fired against the insurgents. Taking advantage of the confusion, the platoon entered the mosque section and eliminates the insurgents. In the end, the core of the building remained intact, as well as the surrounding constructions.

In a counterinsurgency engagement, air and space power alone is never decisive, but serves as a leverage to amplify the efficiency of the ground forces. By providing the joint command with the control of the highs and a good view of the overall situation, it helps to unblock extremely difficult situations on the ground and take the ascendancy over the irregular combatants.

2.5 – Providing a Government Adequate Counterinsurgency Air Power Capabilities

In most insurgency situations, unlike conventional engagements, air and space power never operate independently as a strategic instrument, but rather as an enabler for the ground component. Therefore, based on operational experience of national air forces facing successfully guerrilla movements (Columbia, Sri-Lanka...) a specific pattern of counterinsurgency airpower posture can be identified, based on five key functions.

The first key function is the contribution to the national intelligence architecture. Intelligence from all sources (civil, economic, security, military) and multidisciplinary expertise are essential to the knowledge of irregular forces (intentions, courses of action, capabilities) as well as on the key domains of the cultural and societal backgrounds. The counterinsurgency operations at all levels are intelligence-oriented. Air and space power contributes to this function through dedicated surveillance capabilities on specific areas. In this regard, UAVs and IMINT patrol aircraft are major assets. But other assets, such as combat aircraft, operating in non-traditional ISR have also proven to be very valuable.

The second key function is the operational mobility. Transport helicopters and tactical transport aircraft are essential assets. If properly planned airborne and air assault operations balance the mobility of the insurgents, accelerate the concentration of forces in time and space and expand the reach of counterinsurgency force even to most inaccessible rebel sanctuaries. Airlift offers the most decisive contribution to

⁹¹ Rebecca Grant, « The Fallujah Model », *Air Force Magazine*, Vol. 88, n°2, February 2005, pp. 48-53.

counterinsurgency also by providing the bulk of logistical efforts to sustain the network of forward operating bases, bypassing the ground lines of communication under permanent threats by the insurgents.

The third function is **the architecture of decentralized C²** to increase synergy between the land component and air forces. Although the central management of air operations by a CAOC remains a prerequisite, the counterinsurgency does not require to plan an true air campaign, with its traditional phases and associated target sets. Products of “Strategy” Cell in CAOC, directing the use of airpower as a decisive and coherent instrument, become to large extent irrelevant. However, apportionment of assets and mission assignment must be precisely coordinated with ground forces and, in order to follow the fluid evolution of the tactical situation, must be organized to allow the easy and rapid en-route re-tasking of the aircrafts. Therefore, C² arrangements become even more complicated between CAOC and Joint Operations Center on the theater, in charge with the management of the air space and the ground forces support requirements.

The fourth function is the **precise application of close air support**. It is of a critical importance not only to hit a designated target, but the “right target”. The first requirement is an accurate air-ground coordination system. Tactical commanders hunting down paramilitary units should show a great deal of initiative and be responsive to quick opportunity. The liaison and coordination of air-ground operations should be organized at the battalions or company level with teams of advanced air controllers to designate targets. In Iraq and Afghanistan, more than 85 % of the strikes are guided by terminal “air” controllers on the ground. The efficiency of this air-ground cooperation depends on an accurate situational awareness and the quality and timeliness of information exchanged. It requires therefore a combination of skilled and well-trained ground and airborne controllers (operating from light aircraft such as OV-10 *Bronco*), increasingly supported by data-link systems allowing exchange of target data and imagery in both ways between ground teams and aircrafts. Besides, counterinsurgency CAS is better accomplished by low-speed, long-endurance aircraft able to loiter over the battlefield, and to deliver a wide set of ammunitions (chain gun, precision guided munitions, rockets...). To this regard, combat helicopters, gunships and light aircraft (EMB-314 *Super Tucano* and A-67 *Dragon*) equipped with the necessary avionics and weapons are the best suited platforms.

The fifth function is the **creation of a doctrinal corpus for counterinsurgency and relevant education and training**. This is probably the most difficult task to achieve. Institutional culture of operations is a slow process based on operational experience and evaluation of effectiveness. Foreign assistance could provide local air force with special knowledge and expertise. Nevertheless it is a demanding and time consuming process. Training programs include:

- ➔ Support to joint force: liaison, surveillance, medical evacuation, combat search and rescue;
- ➔ Tactical support to the ground forces: reconnaissance, close air support, interdiction, airlift;
- ➔ Support to Special Forces: infiltration and night-time recovery, resupply, fire support. These missions involve uncommon procedures fitting the requirements of Special Forces courses of action and equipment.

A strong political commitment and a great ability in designing strategies engaging the ground and Special Forces components are the core of all counterinsurgency campaigns. Within this overall framework a rightly tailored air and space instrument could provide the joint forces with the strategic initiative, the operational flexibility, and the tactical lethality required to finally prevail in a protracted struggle against an insurgency.

3 – Mastering Violence Campaign: Stabilizing a Peace Agreement

Hopefully, conventional and counterinsurgency campaigns are not the most common operations. After the end of the Cold War, peace support operations have usually been the bulk of the missions undertaken by multinational forces. Except for airlift, air and space assets have been scarcely used in UN operations. Considering the evolution of “multidimensional peace-keeping” missions now developed by the UN and EU involving military, security and civilian capabilities simultaneously, air and space power becomes also a key enabler for success.

3.1 – Principles for Peace Support and Mastering Violence Engagements

Usually, peace support operations are undertaken within the framework of a negotiated agreement between the warring parties. The strategic objectives are typically to stabilize the security situation, disarm former belligerents and prepare the conditions for reconstruction. This type of campaign requires a holistic approach between local authorities, the military, diplomats and organizations involved in development activities. Military provide security and implement the confidence measures backing the consent of the parties to the agreement. They may also oppose rogue rebels or an unwilling party when acting against the signed agreement. This is a force of interposition confronting no designated enemies in the implementation of the mandate.

There are several types of peace support operations. The most common is a traditional peacekeeping mission, in which a third-party layout is deployed to ensure a neutral implementation of a peace agreement and to monitor closely the demilitarization of a border. These tasks, performed under Chapter VI of the UN Charter with the consent of the parties do not require the use of force and therefore is of little interest for the study.

In contrast, peace enforcement missions are sometimes difficult to achieve. First the international community has to put pressure on belligerents to reach a political agreement through diplomatic, economic and military measures. Secondly, even willing parties may have some difficulties to implement the treaty. In both cases, a limited but nevertheless “convincing” use of force is required to remind everybody to respect the fulfilled agreement (Dayton-Paris agreement in BiH, Operation *Licorne* in Ivory Coast, EUFOR in Chad and the Republic of Central Africa).

“Mastering violence” campaign is a type of operational strategy commonly undertaken by French and the EU-PESD for conducting these operations.

Typically, the tactical problem consist in controlling warring parties with several thousand mobilized people, heavy weapons and sometimes land, air and naval capabilities inherited or withdrew from the stockpiles of the former national armed forces.

A “mastering violence” strategy encompasses six operational dimensions⁹²:

- ➔ Mastering geographic dimensions. At the operational level, the mandated Force may secure an area, to interpose between belligerents, to confine and regroup them, to deny them access to key areas;
- ➔ Mastering humanitarian emergency;
- ➔ Mastering mass movement, for example crowds, rioters or refugees;
- ➔ Mastering armaments, through the disarmament, demobilization and reinsertion (DDR) processes and the generation of a new transitional security apparatus;
- ➔ Mastering belligerents forces, before their demilitarization in the DDR processes. This includes several possible air-ground maneuvers:
 - ⇒ Intimidation maneuver to demonstrate the resolution of the mandated force;
 - ⇒ Warning maneuver implying a measured use of force against symbolic targets of non compliant forces;
 - ⇒ Coercion maneuver to weaken the belligerent position on the political arena and compel him to respect his commitment;
- ➔ Mastering information operations to maintain the support of populations, to counter the influence of violent actors and if necessary to disrupt their decision making process and, finally to ensure the compliance to the terms of the mandate.

3.2 – Air Campaign in Support of Mastering Violence Strategy

Air and space power has potentially a critical role in the implementation of the mastering violence strategy.

- ➔ Airlift and PSYOP can contribute to the mastering of the humanitarian emergency;
- ➔ ISR operations support the verification of the terms of the mandate, particularly for issues related to the deployment of former belligerent forces and the monitoring of demilitarized zones and areas;
- ➔ Airspace can be denied to the air assets of belligerents through the establishment of no-fly zones and counterair operations;
- ➔ Air and space power can provide a major contribution to the mastering of belligerent forces through :
 - ⇒ Show of force;
 - ⇒ Interdiction strikes either directly at C² systems, lines of communication, ground units and facilities or indirectly by infiltrating and supporting raids of Special Forces;
 - ⇒ Comprehensive interdiction operations to disrupt C² and reduce critical capabilities of the targeted belligerent, as key component of the coercion maneuver;
- ➔ Air and space power contributes finally to the information operations with electronic warfare and air-delivered PSYOP products in support of all phases of the campaign.

⁹² Loup Francart, Jean-Jacques Patry, *Maîtriser la violence, Une option stratégique*, Economica, Paris, 1999, 424 p.

3.3 – Intelligence Required Capabilities

Air and space ISR capabilities may significantly contribute to increase intelligence production required to effectively control non-compliant forces:

- ➔ *"Probationary"* intelligence in support of diplomacy activities provide the international community with all information related to the real behavior of a belligerent considering his commitment. IMINT, through the use of electro-optic sensors as well as radar able to penetrate vegetation cover to detect the presence of vehicle; and MASINT sensors (information obtained by measurements and signatures) to detect infrared traces of deployment of vehicles and aircraft are the most useful sources of information for that purpose;
- ➔ Warning intelligence, mainly obtained from IMINT and COMINT, to prevent any aggressive move of the belligerents;
- ➔ Intelligence support to disarmament for detecting weapon caches and unveiling deployment of weapon systems;
- ➔ Tactical intelligence in support of the maneuvers of mastering belligerent forces.





Engagements of unmanned aerial vehicles, helicopters and patrol aircraft (Atlantic 2 engaged in Africa to collect IMINT) are easy considering the low level of risks in peace enforcement environment. Besides, no sophisticated and dynamic targeting layout is required.

The ability to enforce no-fly zones is based on the counterair conventional capabilities provided by combat air patrol and airborne early warning aircraft. Defensive capabilities, especially air defense systems, are sometimes required as shown by the Ivorian SU-25 strikes on the French encampment in Bouake, on 6 November 2004.

In terms of counterland, the show of force may be obtained with low altitude flight and strafing. But maneuvers of warning and coercion may require many interdiction and CAS sorties in support of ground elements of the mandated forces. In this case, the engagement will require strict adherence to the principles of positive identification of the targets and the use of precision-guided munitions.

The negotiated deployment of the mandated force does not obviously require a rapid inter-theater projection or airborne operations. However airlift capability is fulfilling two missions: supporting humanitarian assistance; and assuring the freedom of movement of the mandated force in the country whatever the conditions on the ground. Airlift assets are of critical importance and often heavily tasked. Among them, helicopters are providing the bulk of the available means for CSAR, medevac, long range reconnaissance, liaison and patrol, airmobile raids.

In the realm of information operations, electronic warfare capability is devoted to jam the radars of belligerent forces and disrupt their communication systems as well as their means of radioed propaganda.

	Major Combat Operations	Stability Operations
Theater PSYOP	Less critical Harder to fix Resource-intensive Effects more obscure 	More critical Harder to fix Resource-intensive Effects more obscure 
Tactical PSYOP	Less critical Easier to fix PSYOP comparative advantage (leveraging coercion) 	More critical Fixing requires adjustments to concept and doctrine as well as resources 

Source : Christopher Lamb, *Reviews of Psychological Operations Lessons Learned from Recent Operational Experience*, National Defense University Press, Washington DC, September 2005, p. 99

PSYOP can also support the kinetic effects of a mastering violence strategy. In a protracted campaign, theater-level PSYOP is a purposeful instrument to accompany the achievement of the mid-term end state, and has enough time to produce the desired effects on the parties, although these effects may be uneasy to obtain or difficult to assess in a competing informational environment. The use of aircraft to drop leaflets and broadcast radio messages is sometimes the only way to potentially reach populations in remote areas or held in belligerent's territory.

4 – Intermediate Conclusions

The campaigns described in the previous chapters are based on common core capabilities, and are also characterized by distinct features. The key findings presented below are organized by major functions and proceed of a comparison between the three main types of studied campaigns.

C2 & ISR

Common to these campaigns are;

- ➔ The C² & ISR architecture: ATO and targeting processes, CAOC, (etc.), ability to generate a common operating picture; telecommunication assets (SATCOM, data link), etc.
- ➔ ISR deployed assets including tactical and MALE UAVs, electro-optical IMINT and COMINT sensors, human intelligence.

Conventional campaigns are characterized in particular:

- ➔ By the heavy tasking of satellites and drones, with the ability to monitor a large area or observe conventional intelligence targets (notably conventional forces and infrastructure), both for intelligence and warning purposes;
- ➔ By the ability to operate a comprehensive BDA cycle.

The ability to execute dynamic targeting and to strike hardened and buried targets is a common feature to conventional and irregular war campaigns. The campaigns of stabilization do not require this type of capability since the use of force is limited in intensity.

IMINT radar, ELINT and battlefield surveillance assets, suited to detect the elements of conventional military disposition and equipments are required in conventional campaigns and stabilization operations against military or strong paramilitary forces. These resources are less effective to defeat loosely organized paramilitary forces in irregular warfare.

In most stabilization and irregular warfare campaigns, weak or lack of adversary's air defense capability favors a relative permissive environment in which a wide set of platforms (helicopters, maritime patrol aircraft equipped with IMINT sensors) could be deployed at almost no risk. Nevertheless, in low altitude short range defense systems (guns and MANPADS) remain lethal.

Effectors

Whatever the considered campaigns, a combination of "core" lethal or less lethal effectors is a prerequisite: Precision-guided munitions, platforms protection systems against short-range and low altitude defense, UCAV, attack helicopters, CSAR teams and platforms and tactical PSYOP assets such as leaflets dispensers.

Considering the threat posed by the adversary air and space power, including IADS or ballistic or cruise missiles, Conventional campaigns also require such types of capabilities as:

- ➔ Air superiority capabilities: Fighters (or multipurpose aircraft) and air-to-air missile, air and missile defense system, able to counter offensive aviation as well as the ballistic and cruise missiles of the adversary;
- ➔ Capabilities of in-depth penetration of the enemy territory: Stealth manned bombers and UCAV, cruise missiles, UAVs having the equipment to penetrate the C3 network of adversary IADS via its relay towers.

In conventional campaign as well in campaign of stabilization, SEAD (anti-missile) and electronic warfare both offensive and defensive capabilities are critical elements.

The stabilization and irregular war campaigns frame specific employment:

- ➔ For large platforms with heavy fire power as the gunships, unsophisticated and highly vulnerable strike aircraft at low speed and low altitude;
- ➔ For broadcasting capabilities of strategic PSYOP, since obtaining the support of the population constitutes a central dimension of this type of commitment.

Support

All campaigns require a common core of means, including mainly:

- ➔ Tactical airlift aircraft and transport helicopters;
- ➔ Medical evacuation helicopters;
- ➔ Air Engineering to arrange the bases in the theater;
- ➔ Weather systems;
- ➔ Navigation and positioning.

Conventional campaigns, when they start with a phase of seizing the initiative which imply a forcible entry on the theater, will require the ability to wage an inter-theater maneuver, that mean strategic airlift and air refueling, and possibly in the future of space transportation system to rapidly deploy additional satellites.

Conventional as well as irregular warfare campaigns also require an intensive use of tactical air refueling aircrafts able to project airmobile forces on any place of the theater. The irregular war campaigns also require equipment and human resources to educate and train local air forces.

5 – Air and Space Power in Emergency Relief Operations

International Security at the beginning of the 21st Century includes also the management of situations of large scale humanitarian catastrophes caused by human conflicts or environmental disasters.

Environmental threats to human security either by climate change or technological hazards are now a part of national and multinational security policies in the wake of the Kyoto agreements. The U.N. Intergovernmental Panel on Climate Change, the European initiatives for coordination of national policies for assistance within and outside the European Civil Protection are new fora for debating the issue.

Of course, natural disasters are not new, nor are the use of international assistance programs for assisting the victims. What is new is the permanent monitoring of the media - even in remote areas – focusing the attention of national public opinions on humanitarian consequences. Therefore, a high political pressure induces governments to provide assistance in more or less coordinated way. Air and space power capabilities are often committed in national or multinational frameworks to deliver quickly relief supplies

5.1 – *Features of Emergency Relief Operations*

An emergency relief operation is a typical crisis management engagement and corresponds to several features requiring the use of heavy means using the third dimension. The critical characters of a crisis phenomenon are:

- ➔ A big and sudden event;
- ➔ with large-scale destructive consequences, exceeding the local or regional capacity of protection and response;
- ➔ Demanding an urgent coordinated response;
- ➔ Involving multi-domain assistance in order to restore the proper functioning of local and regional governments;
- ➔ Planned and conducted over time to ensure the necessary transitional period to normalization.

The typical cases are situations of natural or industrial disasters.

The purpose of this kind of operation is often to restore the means of territorial control of local authorities, while providing emergency humanitarian assistance in the meantime.

Many organizations - official or non official - with specific expertise, resources, and agenda are involved in the planning and the conduct of the operation:

- ➔ States, with civil protection capabilities specifically reserved for special situations such as forest fire, major industrial accidents, bio or chemical terrorist attacks. The capacity usually committed is partly military;
- ➔ International organizations with specific missions: The ICRC for assistance to victims and refugees, the UN agencies for food aid, health, education;

- ➔ The non-governmental organizations active in the fields of emergency humanitarian action or development.

In practice, assistance programs are empirically organized, depending on the goodwill of the donors and the ability of local authorities to receive and manage this assistance.

Since the tsunami of winter 2004, it became clear that these international practices were no longer satisfactory because of the nature of the disaster and the geographical extent of the damages. It also appeared clearly that emergency humanitarian assistance was not sufficient and should be coupled with protracted assistance program for reconstruction and normalization. New national and multinational tools are under development to counter the devastating effects of these extreme situations.

5.2 – Military and Civilian Relief Tasks Forces

The commitment of a military joint task force is the first solution adopted by governments for assisting local authorities to cope with crisis situations.

5.2.1 – Military Relief Task Forces: the Example of the Air Expeditionary Task Force-Katrina

In 2005, the hurricane *Katrina* hit the United States, causing considerable damages and civilian casualties, notably in the area of New Orleans.

The Northern Command (NORTHCOM) activated, 28 August, the Joint Task Force-Katrina at Camp Shelby, located in Mississippi. Nearly 58000 National Guard men from fifty states, in addition to the Coast Guard and volunteers from the Civil Air Patrol had been deployed⁹³.

The air component came from the 1st Air Force (HQ in Tyndall, Panama City - Florida). The 1st Aerospace Expeditionary Force-Katrina was created by this structure dedicated to support NORTHCOM. The main tasks given to air and space assets were:

- ➔ The weather monitoring;
- ➔ The aerial reconnaissance of the flooded areas not accessible by land;
- ➔ The air movement of emergency support (engineering) and police ground units;
- ➔ The delivery of equipment of humanitarian and medical assistance;
- ➔ The movement of civilians evacuated out of the devastated areas;
- ➔ The search and rescue of isolated victims.

From an operational perspective, the Joint Force Air Component Commander managed 17000 sorties in fourteen days, involving 390 aircraft of all types in the daily air tasking order, some of which operated from a twenty ships. The results of the operations were⁹⁴:

- ➔ 29000 people transported by air ;
- ➔ 2600 medical evacuations ;

⁹³ Steve Bowman, Lawrence Kapp, *Hurricane Katrina : DoD Disaster Response*, CRS Report for Congress, September 19, 2005, 19 p., p. 5.

⁹⁴ Major John Burbee, "Operation near and dear to their hearts", *The Mapple Leaf*, October 5, 2005.

- ➔ 5300 tons delivered and 12 000 military personnel transported into the joint operations areas.

The helicopters were especially tasked to execute SAR missions. More than 260 machines in active (including Special Forces) and reserve units supported nearly 7 000 victims of the hurricane⁹⁵.

In this episode, as in the earlier Unified Assistance for the benefit of Indonesia, Sri Lanka and Thailand during the tsunami of 2004, joint forces provide an adequate architecture of C² and the availability of key capabilities (engineering, health, transport, communication). These forces may operate unilaterally, but most often in cooperation with other national armed forces.

5.2.2 – Multinational Civilian Task Force

When the military means are lacking, or when the situation requires some specific skills, a second option consists in duplicating a military-like organization for civilian purposes: civil protection, fire fighters, chemical or bio protection units, search and rescue, emergency care.

The project of a European civil protection force proposed in 2006⁹⁶ falls within this logic. The purpose is to create a pool of national means available for interventions in preplanned scenarios of natural disasters (fire, flood, and earthquake), industrial or maritime regional pollution. The coherence of the envisioned protection force should be enhanced by long range airlift capability, specialized helicopters (fire) and interoperable communications among the various stakeholders. A joint education and training center is recommended to bring together the national teams of specialists. The acquisition of a standing pool of long-range liners (Airbus or A-400M) should provide the EU with the right tool for delivering on short notice the bulk of heavy assistance assets (mobile hospitals, generators, water pumps, decontamination equipment...), without waiting the commitment of military aircraft or leased civilian cargos.

The Supported Functions of Emergency Relief Operations

Based on lessons learned from the aforementioned relief operations characteristics and phasing of an air and space campaign especially devoted to humanitarian assistance should rely on ubiquity, flexibility and permanence of effects provided by the aerospace instrument even in a degraded environment.

5.2.3 – Situational Awareness

The first task would be to establish a picture of the situation by identifying damages caused by the disaster on the environment and population. Satellite and aerial reconnaissance capabilities would be oriented to provide a standing monitoring of the area, feeding the civil-military decision making of the operation as well as key operational planning activities including the mapping of the area.

⁹⁵ S. a., Hurricane Katrina Special Edition, *American Defender*, Magazine of the 1st Air Force, Fall 2005, 16 p., p. 9.

⁹⁶ Michel Barnier, *For a European Civil Protection Force : Europ Aid*, Report to the Commission, 9 May 2006, 63 p.

This contribution would be supplemented by the inclusion of international (UN, EU) or national initial reconnaissance teams to draft a multidisciplinary assessment of the needs and priorities. These teams would be inserted by airlift capabilities in degraded areas (tactical aircraft, helicopters) and possibly supported by air reconnaissance systems like UAVs (search for displaced people in remote or non-accessible areas). The main requested aerospace operational functions would be ISR, Support, and Weather Service.

5.2.4 – Evacuation of Population

Either in risk management or in early consequence management, large-scale evacuations of threatened populations and medical support to those most affected require the engagement of massive airlift resources, which would evacuate people into safe land areas or onto vessels (aircraft carriers, hospital ships, barges). Helicopters would be invaluable assets for reaching victims in flooded or remote areas. Operational functions heavily tasked in this phase would probably be Support including SAR and MEDEVAC. Operations would also be conducted from land bases, or even maritime battle groups operating from offshore.

5.2.5 – Restoration of Critical Civilian Infrastructures

The engagement of a joint or civil protection task force is conceivable only in situations of great distress, with a high occurrence of heavy damages on local infrastructure. The deployment of international aid can only be achieved with the restoration of critical infrastructures of communication. Repairing airport infrastructures would become a top priority by restoring air traffic for international assistance. This task is devoted to air engineering units and air traffic control experts. Of course, airlift would be mobilized to transport heavy equipment and civilian specialists working to the emergency restoration of other types of infrastructure (telecommunications, power grid, water, etc.).

5.2.6 – Granting a Total and Permanent Access to Humanitarian Aid

The last mission is to ensure a permanent and total access of the actors of local and international aid to affected areas. Airlift capabilities could either directly deliver the humanitarian aid or indirectly support organizations (IOs and NGOs) in charge of delivering the items. Air and space capabilities should be the enabler for civilian agencies and organizations hampered by geographic or climate constraints.

5.2.7 – Support to Planning and Conduct of Emergency Relief Operations

C² is permanent function whatever the phase of the campaign, ensuring the planning of coherent actions regarding the objectives, the entities involved and the constraints.

Other conceivable contributions, though little used, are related to the information operation. Some Air Forces have PSYOP means of radio broadcasts and dropping leaflets. In some cases, such methods may be useful to inform the populations on the practical conditions of the access to humanitarian aid. Besides, the communication is an important part a crisis response plan. Air and space power contribute by providing releasable ISR information (notably IMINT products) in support of the communication strategy of the political authorities and support the deployment of the teams of journalists.

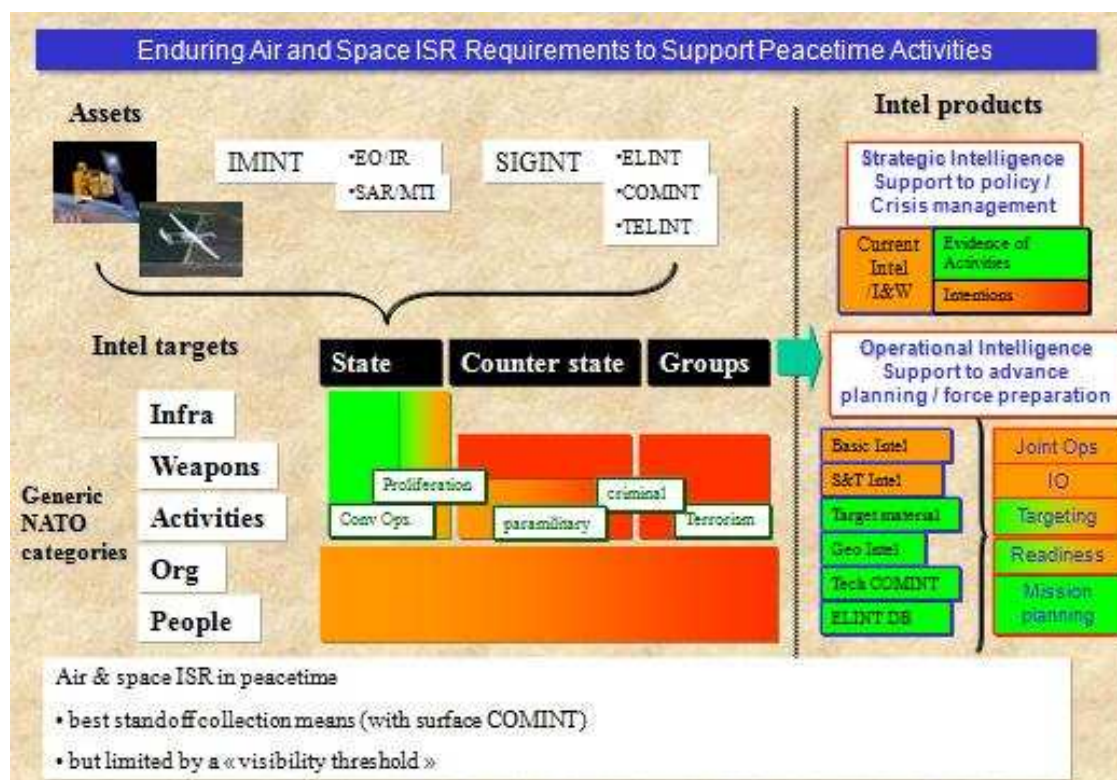
Air and space capabilities could easily be presented to governments and public opinions as key enablers for cooperation and security, in the framework of this new trend of humanitarian campaign. The USA and Japan have developed humanitarian military task forces on their own. China proposed in June 2008 a multinational task force to under the auspices of the ASEAN Regional Forum). The EU is envisioning the European civil protection force. So, the issue is appealing, and provides many opportunities for marketing and public relations purposes.

PART III – ENDURING ENGAGEMENTS OF AIR AND SPACE POWER: NEW DIMENSIONS FOR PREVENTION AND PROTECTION

Air and space power capabilities are not only devoted to contingency campaigns within a specific timeframe and clearly defined concepts of operations. They are also permanently committed in prevention and protection activities. The “standing strategic watch” performed by the intelligence services of States is well known. Beyond this, current engagements encompass maritime security, environmental security layout and missile defense to cope with natural hazards and threats of various types (terrorism and dissemination of weapons of mass destruction).

1 – Standing Peacetime Policy and Advance Planning

The « standing strategic watch » aims to support the country's foreign policy, including its diplomatic activity, the operational readiness of forces, the advance planning as well as the strategy of force development. Specifically, it is carried both by the production of current and basic intelligence on the ongoing crises, force development activities of different targeted countries, and potential operational environments.



The air and space sensors are primarily satellites providing radar and electro-optic IMINT and SIGINT and air platforms providing SIGINT. The space platforms have the great advantage to operate from a stand-off distance. This is also the case of aerial platforms with some limitations compared to the situation of the engagement in a theater: the airborne optical IMINT - which remains the most accurate IMINT source and guarantees uniquely the surveillance of a target - on a foreign sovereign territory is impossible, and ELINT radar IMINT are bounded by a range of several hundred km, conditioned by the performance of sensors and altitude platforms collection.

These collection capabilities are limited by the threshold of visibility of the intelligence targets. Let's take into account the typology of generic NATO basic intelligence - infrastructure, weapon systems, activities, organizations, individuals - and the types of strategic entities declined in the first part of this study. In this context,

- ➔ Regarding the monitoring of States, the air and space intelligence enables primarily the detection and identification of the infrastructure, large weapon systems and the operational activities such as deployments or weapon systems testing gun (through IMINT or telemetric intelligence, TELINT), provided that these activities are not covered by CCD measures. Most current reconnaissance satellites have been specifically designed to fill this role. The usefulness of the means of air and space collection is however much lower to get information about organizations and individuals, and limited to COMINT contributions.
- ➔ When targeting counter state-like entities, the detection of some paramilitary activities and to a lesser extent SIGINT gathering on individuals and organizations are possible, with of course an efficiency that is significantly deteriorated when compared to equivalent intelligence operations against a State;
- ➔ Aerospace Intelligence is, by contrast, of marginal usefulness concerning criminal entities and clandestine cells, and limited to contributions of COMINT in case of very indiscreet targets, and possibly the detection of activities, if the prior guidance was sufficiently precise.

However, the continued and consistently emphasized growth of the volume of telecommunications makes extremely problematic COMINT collection and processing. Furthermore, the monitored entities may use other means of communication than radio transmissions or cell phones, what limits the effectiveness and efficiency of air and space SIGINT capabilities.

In terms of production of intelligence, information provided by air and space collection assets contributes to:

- ➔ The production of strategic intelligence on the monitoring of international crises, confrontations between states and other activities such as NBC proliferation, on the one hand with IMINT on the other hand with COMINT, though more limitedly. Instead, they contribute little to intelligence production on intra-State conflicts and hardly in the prevention of terrorism;
- ➔ The production of operational intelligence in support of advance planning and operational readiness of forces. They are particularly essential for the preparation of targeting material - for example, images for target folders - geographical intelligence - for example, digital terrain models - and the development technical COMINT and ELINT databases – for example in support of electronic warfare.

Kopernikus (ex-Global Monitoring for Environment & Security): a tool for emerging global security policies ⁹⁷.

Kopernikus (formerly GMES) is a joint initiative of the European Union and the European Space Agency. It is designed as a networking air and space and air-maritime capabilities of European countries to provide data in real time to the various potential users that are the players of sector policies (agricultural policy), the European Security and Defense Policy (ESDP) or for achieving the international commitments of the Union in areas of defense of the environment (Kyoto agreement) and the security of citizens (civil protection). Kopernikus is built around an architecture of "information chains" gathering around a specific objective collection capabilities (platforms and sensors), computing, storage (databases), processing and direct dissemination to users. Three "fast tracks" services were selected as priorities for implementation: the Land Monitoring Core Service (LMCS); the Core Marine Service (CMS), and the Emergency Response Core Service (ERCS). This development reflects the shift of persistent watch activities previously reserved for the military to civilian areas in anticipation of risk, humanitarian crisis management and assistance to normalization. The project responds to dual-use which features the operational needs of global security policies. In the case of ERCS, the service is called for actions in natural, technological and conflict crisis situations. It is responsible for providing a mapping of reference of the affected area within less than 6 hours; damages within less than 24 hours with daily updates; and regular forecasts on the evolution of the situation.

2 – Maritime Security

The 9/11 attacks have highlighted the vulnerability of U.S. territory to a foreign terrorist attack. It led Washington to revamp all of its concepts and organizations related to the security of its territory. One aspect of this new security policy is the continuous monitoring of the maritime environment. The White House has therefore published in 2005, *U.S. National Strategy for Maritime Security*⁹⁸, pursuing four objectives:

1. Prevent terrorist attacks and criminal or hostile acts.
2. Protect maritime-related population centers and critical infrastructure
3. Minimize damage and expedite recovery
4. Safeguard the ocean and its resources

This strategy is based on five domains of strategic actions:

- ➔ Enhance International Cooperation;
- ➔ Maximize Domain Awareness;
- ➔ Embed Security into Commercial Practices;
- ➔ Deploy Layered Security;
- ➔ Assure Continuity of the Marine Transportation System.

In this context, the issue of the Maritime Domain Awareness is worth to be developed because it relies for a significant part on the capabilities of air and space power. Then, understandably in light of the foregoing, the American approach involves an

⁹⁷ Edward O'Hara, M. Giannicola Sinisi, *Space Systems for Europe's Security: GMES and Galileo – Reply to the Annual Report of the Council*, Document A/2004, Assembly of the WEU, 4 June 2008, 21 p.

⁹⁸ <http://www.whitehouse.gov/homeland/maritime-security.html>

international partnership on an enormous scale, potentially including all the economic and strategic partners of the United States. By the way, the International Maritime Bureau has changed its procedures. NATO has also launched its own Maritime Situational Awareness (MSA) project.

The targets of this broad situational awareness effort are invariably ships of all types (including notably cargo & containers), the crews and passengers, facilities, infrastructure.

MDA and MSA consider using both classified and unclassified domains to build this situational awareness:

- ➔ The unclassified domain, what the Americans call the Global Maritime Situational Awareness (GMSA), aims to monitor all maritime activities, to detect any abnormalities and to monitor selective vessels in particular. It is to merge all data related to the marine environment to develop a global COP. The data are provided in theory from all possible U.S. and overseas agencies. These unclassified COP primarily use the data collected by transponders installed on ships over 300 tons, similar to Automatic Identification System (which broadcasts permanently) to be completed by the Long Range Identification and Tracking System (LRIT) (which "responds" to ad hoc requests for identification of the authorities who need to know);
- ➔ The data related to abnormalities and ships of potential interest, is confronted with information from intelligence services, what the Americans call the Global Maritime Intelligence (GMI). The ships and other issues of interest are then followed by national or commercial collection means. The aim of GMI is to complement GMSA by supporting a real situational understanding of threats and risks.

Metric criteria used by the U.S. administration appear to have evolved over time. In broad terms, they are:

- ➔ On the high seas, more than 2000 NM from coasts, to detect, classify, identify, and track any vessel over 65 feet long within a 6 hours cycle. The GMSA is fed with LRIT data within 1000 NM from the coast;
 - ⇒ At this stage, it is mainly the space-based radar and ELINT sensors which will be used to collect data from AIS transponders (which emit in VHF) and to track vessels of interest. A recent multinational experiment, using satellites ESA EVISAT and ERS-2 but also SPOT, RADARSAT and NASA MODIS has demonstrated the ability to track vessels by space commercial platforms⁹⁹.
- ➔ In the maritime approaches, less than 200 to 300 NM according to sources, the area where interceptions may take place, to detect, classify, identify, any vessels over 25 feet long in less than 4 hours, and update the situational data every quarter of an hour;
 - ⇒ To monitor the situation in these approaches, studied platforms encompass existing means such as maritime patrol aircrafts as well as UAV HALE / MALE, like the Navy Broad Area Maritime Surveillance (BAMS) using the Global Hawk. They consist also of new systems like Zephyr, a program of solar-

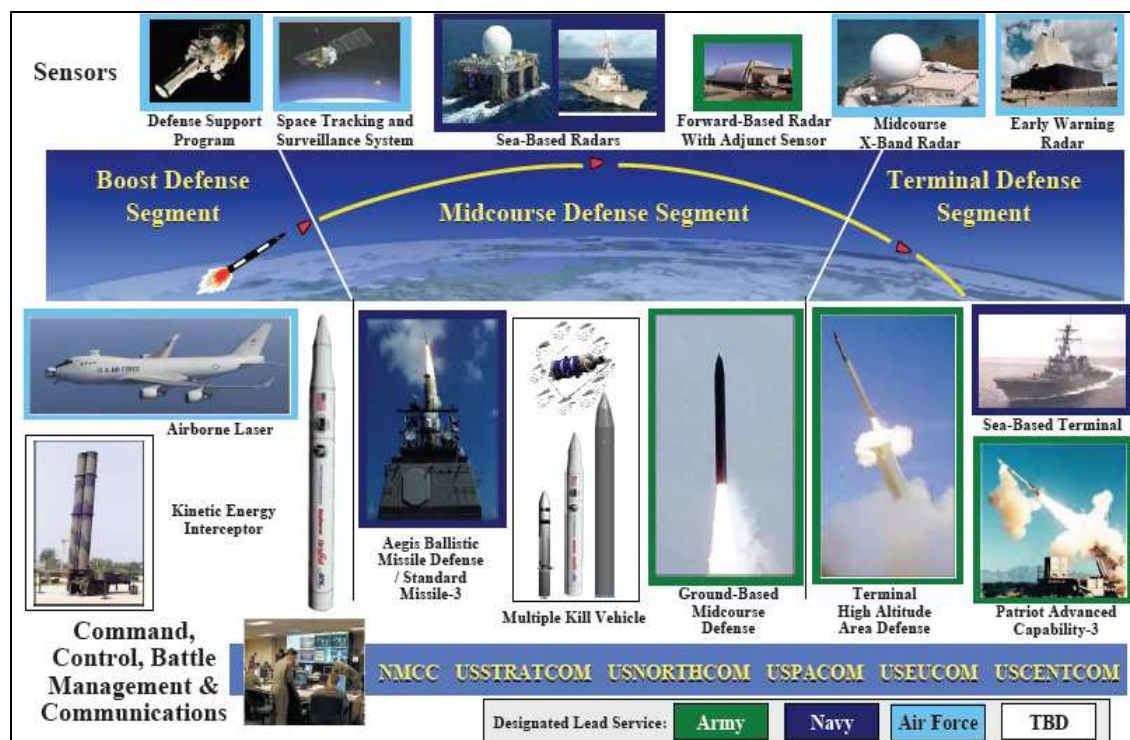
⁹⁹ Hans C. Graber & alii, *Maritime Domain Awareness Experiment*, 2nd International Workshop on Advances in SAR Oceanography and ERS Missions, 21-25 January 2008.

powered drone, and aerostat are also being developed. The sensors are generally electro-optical and radar.

- ➔ In the coastal approaches, a few dozen nautical miles, to identify and track any vessel regardless of its size with updated data per minute or less. In this area, the sensors are extremely diverse: aircraft, UAVs and ground radars.

3 – The Missile Defense

Missile defense is also a key theme of the standing engagement of air and space power. Paradoxically, the number of countries possessing or developing ballistic missiles is lower now than in the late 1980s (21 against 28, including major existing nuclear powers). Several states like South Africa, Brazil and Argentina have put an end to their program. Others such as Libya and Egypt put an end to their vertical proliferation (i.e. the extension of their capabilities). However, under the pressure of short term North Korean and Iranian challenges and the U.S. long term concerns of destabilized nuclear countries such as Pakistan or even China, many countries joined the US missile defense system under development since December 2001.



Source : Lt Gen Trey Obering, USAF Director Missile Defense Agency Ballistic Missile Defense Program Overview, 8 May 2008.

The major characteristics of the U.S. integrated missile defense system, are the following:

- ➔ The system consists in a **C3I Battle Management** function, a combination of satellites using infrared sensors to detect launches and radars to track ballistic missile flight, sensors X-band radar to supplement the monitoring of the missile trajectory and feed data into the interception system. If the X-band radars are well

developed, the new American space sensors – namely the Space Surveillance and Tracking System - suffer from important delays due to problems of management programs;

- ➔ The **engagement capabilities** are based on a layered defense combining systems to intercept ballistic missiles during their boost phase such as the Airborne Laser, at mid-course of their trajectory (ground-based Interceptors and SM-3 missiles fired by the Navy destroyers) in exo-atmosphere for ICBM, and during the descent and terminal phases of their flight (Army Theater High Altitude Area Defense and Patriot PAC-3 and Navy SM-2 Block IV). The effectiveness of these “terminal systems” seems questionable against intercontinental or even intermediate-range ballistic missiles, whose the speed of entry is too fast. The PAC-3 and more recently the GBI and SM-3 are operational;
- ➔ The system transcends levels, strategic and theater, that is to say that the terminal interception systems adapted to intercept short-range on the theater, are fed with the same BMC3I data as the strategic assets like the GBIs.

The Missile Defense Agency Program intends to develop capabilities by incremental blocks:

1. Defense of U.S. from North Korean long-range threats. This phase will be completed in 2009;
2. Defend allies and deployed forces from short-medium range threats –In one theater / region (2010-11);
3. Defend U.S. from Iranian long-range threats (2013);
4. Defend allies and deployed forces from Iranian long-range threats and Expand protection of U.S. Homeland (2013 and after);
5. Defend allies and deployed forces from short-medium range threats –In two theaters / regions.

Except for the Americans, few countries have or are developing such systems, either as part of the American architecture, either in a national perspective, often with the assistance of U.S. or to a lesser extent Russia for terminal defense systems. Most of them are located in “hot spot” or conflict areas:

- ➔ **In North Asia**, Japan will have a sea-based defense co-developed with the Americans and a satellite program. South Korea develops limited terminal interception capabilities.
- ➔ **Israel** deploys with the American support the only operational strategic defense system, based on the Arrow missile;
- ➔ **In Europe**, the Americans push to develop in 2011-2013, as part of their global defense system, radar systems at Thule (Greenland), Flyingdales (UK) and the Czech Republic and a GBI site in Poland. NATO and several national forces also develop theater systems (the Dutch with the PAC-3, Germans and Italians with the MEADS and France's Aster).

In conclusion, if large architectures of continental missile defense could in future reduced in scale by the new Democrat U.S. defense policy as a result of investment choices and geopolitical constraints, programs of theater missile defenses and Space Warning, where the interests of most powers can not be denied, is expected to continue and even expand to new partners.

4 – Conclusion

These engagements of air and space power, excluding specific campaign theater, share common characteristics:

- ➔ They require **permanent** surveillance capabilities, in any case able to achieve **persistent** intelligence support and warning;
- ➔ Such surveillance capabilities but also the engagement ones, in the context of missile defense and maritime security, are continental or even **global** ones;
- ➔ Aerospace power must be integrated into **strategic crisis management** system and not just conflict management ones.

The air and space power through these engagements represents a key asset of these **global security instruments** gradually established at the beginning of the 21st Century.

CONCLUSIONS AND RECOMMANDATIONS

Air and space power is of critical importance, both as a strategic instrument and as an enabler to other major players in the 21st Century international security.

Conclusion 1 – Air and Space Power is a Versatile Instrument Responding Effectively to Contemporary Security Requirements.

Governments will likely use military forces in the future - including air and space power – but in much more sophisticated ways compared to the 20th Century patterns:

- ➔ Conventional protection of territory or region will remain, but;
- ➔ Internal security including the fight against terrorists and paramilitary armed rebels will probably grow in intensity;
- ➔ Security cooperation will be a paramount, in a demanding multinational and interagency environment.

It is even expected that several policies could be undertaken simultaneously. Military capabilities could then be committed in requiring flexibility and responsiveness. Because of its characteristics of ubiquity, speed, long range, air and space power as a strategic instrument is able to match these constraints.

Conclusion 2 – Air and Space Operational Efficiency Involves Specific Postures Corresponding to Security Policies

Air and space power, historically designed and optimized to destroy high value targets and support conventional forces in warfighting, experiences a declining efficiency when oppose to irregular adversaries. An adaptation of posture to specific engagement is a prerequisite to restore an acceptable operational efficiency.

Conclusion 3 –The “Posture Approach” is an Additional Tool Available for Understanding the Needs of Users of Air and Space capabilities

The “posture” approach was made possible by the comparison and analysis of several campaigns involving aerospace means:

- ➔ In strategies of confrontation: Conventional, counterinsurgency and mastering violence campaigns;
- ➔ In new “cooperative” strategies for international security preventing or managing climate, environmental, societal crisis and humanitarian assistance.

Operational requirements vary greatly from one posture to another. Therefore, a close look at the core capabilities and additional capabilities is the key issue to anticipate the right combinations of operational functions required by the user.

Conclusion 4 –The Characteristics of Postures, in Terms of Capabilities, must be Complemented by Concepts and doctrines.

Combining adequate capabilities in coherent strategic posture is not enough to restore an optimal operational performance. Appropriate concepts and doctrines are also necessary. This is probably the most demanding challenge for organizations and institutions in charge of operating the air and space instrument for conventional warfighting. Several years of efforts are required to integrate changes from cycles of lessons learned, education and training activities. Even off-the-shelf experience offered by foreign experts with assistance programs takes a long time for achieving this kind of institutional evolution.

Conclusion 5 – A Mapping Instrument for Providing Guidance to Air and Space Users.

Finally, the knowledge of these generic postures could serve as a mapping of the conceivable shapes of aerospace power a customer would need. It is an available tool for assessing needs, required capabilities and technologies identifying adequate doctrinal options and training programs.

ANNEX 1: TERMINOLOGY USED IN THE STUDY

The terminology used in this study for air and space power operational functions and target systems (tables below) is retained from the USAF doctrine.



Target Systems	
<input type="checkbox"/> C4I: Command, Communications, Computers, and Intelligence.	<input type="checkbox"/> IND: Industry.
<input type="checkbox"/> WMD: Weapons of Mass Destruction.	<input type="checkbox"/> LOC: Transportation / Lines of Communication.
<input type="checkbox"/> GFF: Ground Forces and Facilities.	<input type="checkbox"/> MSS: Military Supply and Storage.
<input type="checkbox"/> AFA: Air Forces and Airfields.	<input type="checkbox"/> SCT: Special Category (paramilitary organization, terrorists groups, drug trafficking, special forces).
<input type="checkbox"/> ADF: Air Defense Forces.	<input type="checkbox"/> MLS: Military Leadership.
<input type="checkbox"/> NFP: Naval Forces and Ports.	<input type="checkbox"/> PLS: Political Leadership.
<input type="checkbox"/> SPF: Space Forces.	<input type="checkbox"/> ELS: Economic Leadership.
<input type="checkbox"/> MSL: Ballistic Missiles.	<input type="checkbox"/> GEP: General Public.
<input type="checkbox"/> PWR: Electric Power.	<input type="checkbox"/> AME: Adversary Media.
<input type="checkbox"/> POL: Petroleum, Oil, and Lubricants Industry.	

US Definitions of effects¹⁰⁰ :

Attrit	To destroy or kill (troops, for example) by use of firepower
Compel	1) To force, drive or constrain 2) To make necessary
Convince	1) To overcome by argument 2) To bring to belief, consent, or a course of action (COA)
Damage	To reduce the soundness, effectiveness, or perfection of
Deceive	To cause to believe what is not true.
Degrade	1) Damage done to the function is permanent, but only portions of the function were affected; that is, the function still operates, but not fully. 2) A function's operation is permanently impaired, but the damage does not extend to all facets of the function's operation.
Deny	1) To hinder the enemy the use of space, personnel, or facilities. It may include destruction, removal, contamination, or erection of obstructions. 2) Damage done to the function is only temporary, but all aspects of the function were affected. 3) A function's operation is impaired over the short term, but the damage extends to all facets of the function's operation.
Delay (operation)	1) To slow down the arrival of a unit on the "battlefield." 2) An operation in which a force under pressure trades space for time by slowing down the enemy's momentum and inflicting maximum damage on the enemy without, in principle, becoming decisively engaged.
Destroy	1) To damage the condition of the target so that it cannot function as intended nor be restored to a usable condition. 2) Damage done to the function is permanent, and all aspects of the function have been affected. 3) A function's operation is permanently impaired, and the damage extends to all facets of the function's operation.
Diminish	1) To make less or cause to appear less. 2) To reduce the effectiveness of an activity. This is similar to degrade without the kinetic overtones.
Disrupt	1) To break apart, disturb, or interrupt a function. 2) Damage done to the function is temporary, and only portions of the function were affected. 3) A function's operation is impaired over the short term and the damage does not extend to all facets of the function's operation.

¹⁰⁰ Joint Warfighting Center, *Joint Fires and Targeting Handbook*, US Joint Forces Command, 19 October 2007, http://www.dtic.mil/doctrine/jwfc_pam.htm

Divert	To restrict the enemy's capabilities to pursue a particular COA.
Enhance	To increase or make greater the capabilities of a force or a people.
Exploit	To gather information that will enable opposition ability to conduct operations to induce other Effects.
Expose	1) To make known or cause to be visible to public view. 2) To make visible, to reveal something undesirable or injurious.
Harass	To disturb the rest of enemy troops, curtail their movement and lower morale by threat of loss.
Influence	1) Selected projection or distortion of the truth to persuade the opposition to act in a manner detrimental to mission accomplishment while benefiting accomplishment of friendly objectives. 2) To cause a change in the character, thought, or action of a particular entity.
Inform	To impart information or knowledge.
Limit	To reduce the options or COAs available to the enemy commander.
Mislead	To create a false perception that leads the opposition to act in a manner detrimental to mission accomplishment while benefiting accomplishment of friendly objectives.
(Negate/) Neutralize	1) To render an enemy weapon system and maneuver units ineffective or unusable for a specific period of time. 2) To render ineffective, invalid or unable to perform a particular task or function. 3) To counteract the activity or effect of.
Prevent	1) To deprive of hope or power of acting or succeeding. 2) To keep from happening, to avert.
Protect/ Safeguard	1) To cover or shield from exposure, damage, or destruction. 2) To keep from harm, attack, injury or exploitation. 3) To maintain the status or integrity of.
Shape	1) To determine or direct the course of events. 2) To modify behavior by rewarding changes those tend toward a desired response. 3) To cause to conform to a particular form or pattern.
Suppress (ion)	1) Involves temporary or transient degradation of an actual or suspected enemy weapons system for the purpose of degrading its performance below the level needed to fulfill its mission objectives at a specific time for a specified duration. 2) Temporary or transient degradation by an opposing force of the performance of a weapons system below the level needed to fulfill its mission objectives.
Usurp	1) To seize and hold, as the power, position, or rights of another, by force and without right or authority 2) To take over or occupy physically, as territory or possessions.