From effects-based operations to effects-based force : on causality, complex adaptive system, and the biology of war

Jobaggy, Z.

FROM EFFECTS-BASED OPERATIONS TO EFFECTS-BASED FORCE: ON CAUSALITY, COMPLEX ADAPTIVE SYSTEM, AND THE BIOLOGY OF WAR

Proefschrift

ter verkrijging van

de graad van Doctor aan de Universiteit Leiden,

op gezag van Rector Magnificus prof.mr. P.F. van der Heijden,

volgens besluit van het College voor Promoties

te verdedigen op donderdag 08 oktober 2009

klokke 13.45 uur

door

Zoltán Jobbágy

geboren te Boedapest

in 1968

PROMOTIECOMISSIE

Promotor:
Prof. Dr. R. de Wijk

Co-Promotor:
Dr. H. Pellikaan

Referent
Prof. Dr. M. Hosli

Overige leden
Prof. Dr. J. S. van der Meulen
Prof. Dr. J. W. de Beus (Universiteit van Amsterdan)
Prof. Dr. M. J. Faber (Vrije Universiteit Amsterdam)
Prof. Dr. R. A. Koole

De totstandkoming van dit proefschrift werd financieel mogelijk gemaakt door de Nederlandse Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek (TNO) en het Hongaarse Ministerie van Defensie

MOTHER COURAGE:
“That must be a rotten general.”

THE COOK:
“He’s ravenous all right, but why rotten?”

MOTHER COURAGE:
“Because he’s got to have men of courage, that’s why. If he knew how to plan a proper campaign what would he be needing men of courage for? Ordinary ones would do. It’s always the same; whenever there’s a load of special virtues around it means something stinks.”

THE COOK:
“I thought it meant things is all right.”

(BERTOLT BRECHT)

Acknowledgement

This thesis is my own, but it is fair to mention that it has also benefited from the advice and support of many people.

In respect to TNO and the Hungarian Ministry of Defence, I would like to thank Mr. Michel Rademaker, Dr. Mirko Pokorny, Dr. Levente Komor and Col. Gábor Nagy, who all worked persistently on the realisation of this research project.

Special thanks go to Col. Dr. János Krizbai, the Hungarian scientific supervisor who always encouraged me despite problems and doubts that appeared during the four years.

Further thanks go in alphabetical order to Brig.-Gen. (Retd.) J. M. J. Bosch, Dr. Paul K. Davis, Dr. Guy Duchynski, Mr. John P. Hunerwadel, Maj.-Gen. (Retd.) Frank van Kappen, Mr. Jaap Koole, Mr. Norman K. Ma, Dr. Ton van Oosterhout, Col. Dr. Frans Osinga, Mr. Ian Tamm, and Mr. Douglas E. Webster. They all provided me with precious advice regarding the research direction and content.

In reducing grammatical inconsistencies and phrases jarring to the native English ear I am deeply indebted to assistant editor Capt. (Retd.) Charles Culpepper, United States Army, from Defence Transformation Department, The Hague Center for Strategic Studies.

Last but not least, I would like to thank to Mr. Martin Meulenbroek from TNO Library who provided the books, articles and papers I requested during the research.

This study reflects my best intention to synthesise the results of a long and beautiful journey across various fields of scientific thought. However, should the reader disagree either fully or entirely with its content, I can just refer to the historian Henry Adams who wrote that “if anyone wants to differ from me I am prepared to agree with him.”

English Summary

The author addresses a recent force employment concept called *effects-based operations*. It first appeared during the 1991 war against Iraq in which the incredible potential of advanced technologies such as stealthy platforms and precision weaponry, was in the global media. The new concept emphasised the primer of achieving effects on the enemy and disregarded large-scale destruction. Soon effects-based operations became a buzzword in the military lexicon and synonymous with Western, especially American, technological superiority. Over the years the concept proved so durable that it increasingly permeated military and political thinking. The attributes of effects-based operations can be grouped around three common, but interrelated elements such as *effects focus*, *advanced technology*, and *systems thinking*.

The characteristics upon which the common elements are built, such as *causality/deduction* for effects focus, *intangibles/control* for advanced technology, and *categorisation/analysis* for systems thinking bear dangerous simplifications regarding the nature of war. It is certainly true that differences in weapons systems and scientific standards can shift the relative balance to one's favour and often in a decisive fashion. However, the attributes of effects-based operations are in sharp contrast with war's frictional nature as outlined by Clausewitz. According to him effects in war cannot be traced back to single causes, as several concurrent causes are normally at work. Investigating the relationship between causes and effects becomes easy only if they are closely linked. An effect that appears correct at one level can become objectionable on a higher level and imply a new basis for judgement. The distance between causes and effects is proportionate to the number of other factors to be considered.

Thus friction is not a technical problem that can be eliminated. Novelty must always be expected in war, which indicates that effects are never predictable with a high degree of certainty. Friction always dims expectations in terms of causality and the ability to achieve desired effects. The consequence is that in war we must be satisfied with understanding certain general features in terms of correlation, rather than attempting to discover a mechanism that links causes with effects directly. The author suggests an organic approach to address the challenge posed by war. According to him the emphasis must shift towards learning and adaptation, instead of planning for desired effects. Although this approach does not allow for perfect solutions, it can guarantee an alignment in terms of external demand and internal variation. There is simply too much going on in war that does not allow every move to be orchestrated from the top, but often require uncontrolled and parallel actions.

Consequently, in war the central challenge is to manage change, which requires a certain amount of flexiblity. Wars happen on multiple levels ranging from the top at headquarters to below at the front lines.Addressing the challenges posed by the enemy requires more than causal assumptions imposing unnecessary constraints. This way it becomes possible to exploit friction's uncertainty and complexity that Clausewitz associated with war. Friction indicates that often it is more important in war how we do things than what things we do, which has a clear practical limitation for the concept of effects-based operations.

Dutch Summary

Een recent concept voor het gebruik van militaire macht is *effects-based operations* (effectgebaseerde operaties). Dit concept werd door de Amerikanen voor het eerst in 1991 tijdens de oorlog tegen Irak toegepast. Het potentieel van geavanceerde technologieën zoals 'stealthy' platformen en precisiewapens werd onderwerp van een wetenschappelijk en politiek debat, vooral omdat het nieuwe concept zicht bood op het bereiken van een effect op de tegenstander zonder grootschalige vernietiging. Het concept van de *effects-based operations* werd daardoor synoniem voor de Westerse – met name de Amerikaanse – technologische suprematie. Het bleek uiteindelijk zo duurzaam dat het zich wortelde in het Westerse militaire en politieke denken. De kenmerken van *effects-based operations* kunnen worden gegroepeerd rond drie met elkaar samenhangende elementen: *focus op effect*, *geavanceerde technologie* en *denken in systemen*.

De karakteristieken waarop deze gemeenschappelijke elementen zijn gebaseerd, namelijk *causaliteit/deductie* voor de focus op effect, *ondefinieerbaarheid/controle* voor geavanceerde technologie en *categorisering/analyse* voor het denken in systemen, brengen echter ten aanzien van de aard van oorlog een gevaarlijke versimpeling met zich mee. Het is zeker waar dat verschillen in wapensystemen en wetenschappelijke ontwikkelingen de relatieve balans in het voordeel van één van de partijen kan doen doorslaan en zelfs beslissend kan zijn. Maar de kenmerken van *effects-based operations* vertonen een scherp contrast met de natuurlijke frictie in oorlogen zoals die door Von Clausewitz is beschreven. Volgens Von Clausewitz kunnen gevolgen in een oorlog niet worden teruggevoerd op enkele oorzaken, omdat normaliter verschillende samenvallende oorzaken in het spel zijn. Daardoor is er een groot verschil tussen oorlog in theorie en oorlog in de praktijk.

Het onderzoeken van de relatie tussen de oorzaken en de gevolgen is alleen goed mogelijk indien deze expliciet met elkaar verbonden zijn. Een gevolg dat op het ene niveau juist lijkt, kan op een hoger niveau van analyse onjuist zijn en leiden tot een nieuw oordeel. De afstand tussen oorzaak en gevolg staat in relatie tot de andere factoren die moeten worden meegewogen. Daarom is frictie niet slechts een technisch probleem dat kan worden geëlimineerd. In oorlog moet voortdurend met nieuwe, onvoorspelbare ontwikkelingen rekening worden gehouden. Dit betekent dat de gevolgen van oorlogshandelingen nooit met een hoge mate van zekerheid voorspelbaar zijn. Door frictie zoals gedefinieerd door Von Clausewitz, is de verwachte causaliteit en het vermogen om de gewenste effecten teweeg te brengen daarom per definitie onduidelijk. Derhalve moeten wij ons bij oorlogsvoering tevredenstellen met het begrijpen van de correlatie tussen algemene kenmerken in plaats van het ontdekken van een mechanisme dat oorzaken en gevolgen logisch met elkaar verbindt.

In deze studie wordt een organische benadering voorgesteld voor deze uitdaging van de oorlogsvoering. In de visie van de auteur moet de nadruk worden verschoven naar leren en aanpassing in plaats van planning om de gewenste effecten te bereiken. Hoewel deze aanpak geen perfecte oplossingen biedt, geeft deze wel de garantie dat de externe vraag en de interne variatie op één lijn worden gebracht. In een oorlog gebeurt er te veel, zodat niet iedere stap

hiërarchisch kan worden gedirigeerd en er vaak ongecontroleerde en parallelle acties plaatsvinden. Als gevolg hiervan is de centrale uitdaging het managen van verandering. Dit vraagt om een zekere mate van flexibiliteit. Oorlog vindt op verschillende niveaus plaats, van de politieke en militaire top tot de mannen en vrouwen in de frontlinie. Om de uitdagingen die door de vijand worden gesteld aan te kunnen is meer nodig dan causale aannames die onnodige beperkingen opleggen. Op deze manier wordt het mogelijk om de onzekerheid en complexiteit van frictie die Von Clausewitz met oorlogvoeren associeerde te benutten. Frictie toont dat het in oorlog vaak belangrijker is hoe we dingen doen dan welke dingen we doen. Dit leidt tot een duidelijke praktische begrenzing van het concept van de *effects-based operations*.

Contents

Introduction

"… military has no constant form, just as water has no constant shape – adapt as you face the enemy, without letting them know beforehand what you are going to do. Therefore, assessment of the enemy is in the mind, observation of the situation is in the eyes."

Sun Tzu

Waves of History

The social wave-front analysis regards history as a succession of three waves of change. The basic assumption is that human social development has been interrupted by innovations and breakpoints generating waves moving at a certain speed.[1] The social wave-front analysis also explains how wars have changed as the waves accumulated their force. A thorough understanding of the waves is of utmost importance, since the general conclusion is that every time the waves clash, bloody wars erupt, as tensions between the representatives of different waves accumulate.[2] It is commonplace to say that the West is biased towards the instrumental dimension of war and regards it as a means towards an end. In contrast, most challengers are driven by war's existential dimension and regard it as an end in itself.[3] It appears that the technology-driven warfare of the West increasingly faces an ideologically driven warfare which partly explains why troops of the coalition still fight in Iraq. Although President George W. Bush declared the war to be over in 2003, efforts to harvest peace cost the United States billions of dollars each month.[4] This bias towards the instrumental dimension indicates that the West is unable to understand the existential dimension and its expressive elements. It is not able to see violence in a social context, and ignores that cruelty and destructiveness of war express basic social conditions. According to the social wave-front analysis, the way we generate wealth and the way we wage war are connected. War is part of our social existence, and reflects the society with which it evolves in consonance. Understanding the social context is critical. Throughout human history wars were mostly waged by social entities other than states, fought by social organisations other than armies, and with the involvement of combatants other than soldiers.

---

1 Toffler, Alvin: *The Third Wave,* Bantam Books, 1980, pp. 10-12.

2 Toffler, Alvin/Toffler, Heidi: *War and Anti-War, Survival at the Dawn of the 21st Century,* Little, Brown and Company, 1993, pp. 19-25.

3 Coker, Christopher: *Waging War Without Warriors, The Changing Culture of Military Conflict,* IISS Studies In International Security, Lynne Rienner Publishers Inc, 2002, pp. 6-13; Ho, Joshua: *The Advent of a New Way of War: Theory and Practice of Effects Based Operations,* Working Paper Series No. 57, Institute of Defence and Strategic Studies, Singapore, December 2003, pp. 23-24.

4 Lind, William S. et. al.: *The Changing Face of War: Into the Fourth Generation,* Marine Corps Gazette, November 2001, pp. 66-68; Crawley, James W.: *Rising War Costs, Monthly War Spending Passes $ 5.8 Billion,* Media General News Service, Internet, accessed 01. 12. 2004, available at www.globalsecurity.org/org/news/2004/041119-iraq-burn-rate.htm.

Clausewitz acknowledged that in war nothing is eternal and there could be "little doubt that many previous ways of fighting [would] reappear".[5] Due to its instrumental bias the West assumes wars to be short, decisive and rational. As Hobbes pointed out, time simply increases suffering and destruction. The essence of war was for him, not battle or the act of fighting, but the consumption of time. Consequently, the longer the duration, the greater the enemy has to suffer. The more he suffers the less he has to lose, and the greater his determination that the suffering not ought to be in vain.[6] Time stands for destructive effects, which possess significance on all levels of war. Iraq has shown so far that what matters is not the way the West sees victory, but the way the enemy understands defeat. Military involvements of the recent past have been elongated as the emphasis slowly shifted from winning the war towards winning the peace. Paradoxically, hearts and minds campaigns demonstrate that military performance on the battlefield is less and less relevant as involvements tend to be lengthy, measured in years, not days, weeks or months.[7] According to the social wave-front analysis, during much of human history wars tended to be non-decisive, protracted engagements fought for limited objectives and by limited means. Thus they were a permanent way of life, mostly conceived as a natural phenomenon. Most enemies the West faces represent earlier waves and see war from a different perspective. They fight for different aims and by different means.[8] It appears that the West employs its military force in a way, geared to maximize lethal efficiency, as their capability to kill is unparalleled. However, political effectiveness often counts more than military efficiency and in some cases indicators of theoretical efficiency might be irrelevant to battlefield effectiveness. Despite the technological wizardry of the Western armed forces, we should bear in mind that continuity in war is at least as important as change.[9]

Characteristics of the Last Wave

Unlike the symmetric threat of the Cold War, military involvements of Western armed forces in the outgoing 20th century were confusing, distant, and squalid, rather than decisive or heroic. In the framework of the social wave-front analysis we can say that similar conflicts held off large armies during the First Wave when the price to be paid seemed too high, or the gain too small for empire builders. Western expansion and colonialism during the Second Wave proved that primitive or imperfect warfare could not defeat modern armies supported by advanced technologies and organisation. In the context of the Third Wave political and psychological

---

5 Coker, p. 6; Clausewitz, Carl von: *On War,* Everyman's Library, 1993, pp. 84, 101, 173; Hammes, Thomas X.: *The Sling and the Stone, On War in the 21st Century,* Zenith Press, 2004, p. 3; Toffler/Toffler, p. 64; Creveld, Martin van: *The Transformation of War,* The Free Press, 1991, p. 73; Quotation in Clausewitz, p. 624.

6 Hobbes, Thomas: *Leviathan,* Oxford University Press, 1996, p. 84; Creveld (1991), p. 144.

7 Clausewitz, p. 246; Hammes, pp. 208-209.

8 Wegman, Yehuda: *Israel's Security Doctrine and the Trap of "Limited Conflict",* Military Technology, March 2005, pp. 86-89; Clausewitz, p. 608.

9 Hammes pp. 16-32, 207-215; See also Wilson, G. I. (Col.)/Sullivan, John P. (Sgt.)/Kempfer, Hal (Lt. Col.): *Fourth Generation Warfare, It's Here, And We Need New Intelligence-Gathering Techniques For Dealing With It*, Armed Forces Journal, International, October 2002, pp. 56-62; Wilcox, Greg/Wilson, Gary I.: *Military Response to Fourth Generation Warfare in Afghanistan,* Internet, accessed 23. 09. 2002, available at www.emergency.com/2002/4gw5may02.htm; Knox, MacGregor/Murray, Williamson: *The Dynamics of Military Revolution 1300-2050,* Cambridge University Press, 2001, p. 192; Biddle, Stephen: *Afghanistan and the Future of Warfare,* Foreign Affairs, March/April 2003, p. 46.

factors often predominate over traditional military ones.[10] The West's instrumental bias approaches war mainly in terms of ends/means rationality. It assumes that through analysis and deduction it is possible to detect causal relationships that can be exploited by the application of superior military technology. This logical and essentially scientific image of war focusing on the efficient application of scarce resources explains the West's preference for a concept such as *effects-based operations*. Unfortunately, the social wave-front analysis indicates that wars the West wants to fight and wars it will have to fight might not fully overlap.[11] The international political system of the Third Wave is often described as the age of complexity or post-modern. It is characterised by several parallel revolutions in information related technologies, a continuous geo-strategic restructuring, and the diminishing role of national governments. Globalisation also indicates that traditional poles of attraction are braking down as the boundaries and dividing lines in the international arena evaporate. The Second Wave allowed for discernible principles and boundaries, but the Third Wave stands for a constant fragmentation.[12] There are many actors of different types who display a wide variety of relations including both alignments and enmities. Globalisation also demonstrates that many issues lack a dominant axis in terms of co-operation and conflict. Various patches on global and regional scales emerge constantly, thus featuring both enclaves of order and disorder. Power is distributed in a manner in which allies on one particular issue might be adversaries on another. This dynamic is extremely war-prone and contains highly anarchistic enclaves outside the traditional boundaries of the nation state. Various forms of violence flourish, which are often accompanied by the inability of governments to satisfy the requirements and expectations of their citizenry. The Second Wave stood for a multitude of conventional wars between ambitious and capable states. In the Third Wave the West will be increasingly required to wage mainly unconventional wars against failed states with populations fuelled by a rage born from the triumvirate of hopeless poverty, wealth discrepancies, and various religious motives. The majority of conflicts in which Western armed forces fight are already asymmetric. Unconventional enemies such as Al Qaeda indicate both new and hybrid forms of violence, which pose tremendous problems. Enemies do not look, think and fight like us and it is extremely difficult to understand their motives and behaviour. Fighting such enemies can not only negate the West's technological advantages and its analytical skills, but also dangerously stretch available resources. More and more Western soldiers must engage with the enemy on his ground and according to his rules.[13]

Asymmetric and Unconventional Conflicts

The majority of security challenges usually occur in failed states with collapsed institutions. They tend to unfold in the less developed parts of the world displaying the characteristics of earlier

---

[10] Gray, Chris H.: *Postmodern War, The New Politics of Conflict,* Routledge London, 1997, pp. 21-23, 81, 155-158, 168-177, 196.

[11] Liotta, P. H.: *Chaos as Strategy,* Parameters, Summer 2002, pp. 47-56.

[12] Binnedijk, Hans: *A Strategic Assessment for the 21st Century,* Joint Force Quarterly, Autumn 1996, p. 67; Lyotard, Jean-François: *The Postmodern Condition: A Report on Knowledge*, University of Minnesota Press, 1984, pp. 14-17; Kumar, Krishan: *From Post-Industrial to Post-Modern Society, New Theories for the Contemporary World*, Blackwell, 1995, pp. 101-104.

[13] Brown, Seyom: *The Illusion of Control, Force and Foreign Policy in the 21st Century,* Brookings Institution Press, 2003, pp. 67-69; Peters, Ralph: *Fighting for the Future, Will America Triumph?* Stackpole Books, 1999, pp. 1-17.

waves. The armaments and tactics of low intensity conflicts rarely allow for the involvement of regular armies. This fosters a blurring of the traditional distinction between war and crime and poses a significant challenge to the West, who traditionally makes a distinction between civilized and savage forms of warfare. Whereas the former is assumed to be rational, directed and essentially non-violent, the latter is often seen as irrational, aimless and bloody.[14] Thus waging war depends for the West more on technology and wealth, rather than manpower and ideology. The focus on short and sharp campaigns resulting in few casualties also explains why Western armed forces are not driven by religious or ideological motives. Unfortunately, in asymmetric and unconventional conflicts, the traditional understanding of war as the clash between regular armed forces fighting for secular political reasons, does not apply. The proliferation of technology enables non-state actors to play an increasing role in international politics. The growing number of ungoverned territories within a number of weak states easily provides for safe haven for international terrorist and criminal organisations.[15] The collapse of the World Trade Center in 2001 meant that war and terrorism merged. They pose a constant and considerable threat to international security and raise the chance to have diametrically opposed civilisations. Although the challengers might appear as representatives of earlier waves, their intention bears serious political consequences. *Their* aim is to remove alien influences from *their* world and change the basic constellation of the international system. The character and nature of such challengers is best described as *anti-systemic terrorism*, which refers to the unconventional, but world-wide use of force by non-state or state-sponsored actors. This sort of terrorism aims at destroying and killing civilian and government facilities and personnel in order to induce changes in the international system. Taking advantage of the accelerating globalisation, representatives of earlier waves try to make their impact global, as they increasingly use the technological arsenal of the emerging Third Wave.[16] The declaration of the American President George W. Bush on 20 September 2001 made war a general phenomenon fought interminably and on a global scale, which will end only if every terrorist group of global reach has been found and defeated. The global effort to fight international terrorism turned war into a perpetual and indeterminate phenomenon with no clear distinction between the state of peace and that of war. Waging war against such asymmetric and unconventional enemies indicates that war's traditional dimensions are about to blur geographically and temporally. The enemy is elusive and operates outside the traditional boundaries of the nation state. He is no longer a comprehensible and localisable entity, but one whose nature is fleeting and difficult to grasp. He is mostly unknown, unseen and yet ever present. He poses a constant threat in which legitimate violence, criminality, and terrorism merge and become indistinguishable from another. Fighting and defeating him means that war is not the final element in the sequence of power, but by merging with the other

---

[14] Laroque, Emma: *The Metis in English Canadian Literature,* The Canadian Journal of Native Studies, Volume III, Number I, 1983, p. 86.

[15] Nye, Joseph S. Jr.: *U.S. Power and Strategy After Iraq,* Foreign Affairs, July/August 2003, pp. 62-63, Hooker, pp. 11, 14.

[16] Dorff, Robert H.: *Democratization and Failed States: The Challenge of Ungovernability,* Parameters, Summer 1996, pp. 17-23; Barber, Benjamin: *Jihad vs. McWorld,* The Alantic Monthly, Volume 269, Number 3, March 1992, pp. 53-65; Wijk, Rob de*: The Art of Military Coercion, Why the West's Military Superiority Scarcely Matters,* Mets & Schilt, 2005, pp. 170-184; Kaplan, Robert A.: *"The Coming Anarchy" and the Nation-State Under Siege,* Peaceworks, Number 4, United States Institute of Peace, 1995, pp. 5-12; Kibble, David G.: *The Attacks of 9/11: Evidence of a Clash of Religions?*, Parameters, Autumn 2002, pp. 34-45.

elements it can become the very foundation of politics.[17] Waging such wars is both demanding and difficult. Operations require the co-ordination of multiple actors, and contain a multitude of challenges and tasks. Asymmetric and unconventional enemies stand for complex contingencies, which can be understood as much by what they are as by what they are not. Thus detecting decision points can be very difficult.[18] This attribute resembles similarity with a never-ending decision tree. Asymmetric and unconventional enemies tend to appear in networks, which are variable, uneven and indefinite. Although they have no clear centre at all, their nodes can exchange information directly, which makes possible for them to appear anywhere and strike anytime. The bombings in Madrid in 2004 and London in 2005 showed that an enemy acting as an amorphous multiplicity or *swarm* can strike at any point, from any sides and at any time, and disperse so as to become nearly invisible.[19]

Existential Dimension, Expressive Element

Fighting such networks is similar to that of guerrillas, but on a global scale. As one senior U.S. general remarked it is inherently difficult, in some cases impossible. It can drag soldiers easily into "vague, confusing military actions" in which they have to master "each messy situation and pull everything together."[20] The conduct of asymmetric and unconventional warfare is not only confusing, but also paradoxical. It contains fragments of older forms including modern, ancient, and even ritual war. As various types of vacuum and cluster bombs have already displayed, even conventional weapons can have unconventional effects.[21] Increased dependence on technology can mean that even actions that are regarded insignificant in traditional terms, often need political preparation and justification. Despite the asymmetry of technological capability, often the best Western armed forces can achieve is not to lose militarily. Asymmetric warfare is inherently political in which victory often means hurting, rather than defeating, a superior enemy.[22] As various guerrilla wars of the 20th century showed, wars can be lost militarily, but won politically. Western military thinking still does not understand why, that given its technological superiority, the outstanding education and training of its military personnel, do enemies fight wars they cannot win based on rational calculation? The tides seem to change and it appears that in a globalised world, traditional factors such as gross national product, research and development capabilities, organisational and management skills are becoming less and less

---

17 *Address to a Joint Session of Congress and the American People,* United States Capitol, Washington D. C., Internet, accessed 03. 08. 2005, available at www.whitehouse.gov/news/releases/2001/09/20010920-8.html; Hardt, Michael/Negri, Antonio: *Multitude: War and Democracy in the Age of Empire*, Penguin Press, 2004, pp. 3-21, 30-32.

18 Byman, D./Lesser, I./Bruce, P./Benard, C./Waxman, M.: *Strengthening the Partnership, Improving Military Coordination with Relief Agencies and Allies in Humanitarian Operations,* RAND MR-1185-AF, 2000, pp. 7-11.

19 Ibid., pp. 54-58; Edwards, Sean J. A.: *Swarming on the Battlefield: Past, Present, and Future,* RAND MR-1100-OSD, 2000, pp. 53-63 and Edwards, Sean J.: *Swarming and the Future of Warfare*, Dissertation, Pardee RAND Graduate School, 2004, pp. 99-113.

20 Zinni, Anthony C.: *A Commander Reflects, What will be the operations of the future?* Proceedings, July 2000, pp. 34-36 (quotations p. 34).

21 Kellner, Douglas: *Postmodern Military and Permanent War,* in: Boggs, Carl (ed.): *Masters of War, Militarism and Blowback in the Era of American Empire,* Routledge, 2003, pp. 229-244.

22 Hanson, Victor D.: *Postmodern War,* City Journal, Winter 2005, Internet, accessed 08. 03. 2005, available at www.city-journal.org/html/15_1_postmodern_war.html.

the decisive factors for victory in war.[23] The social wave-front analysis indicates that technologies come and go, but the primitive endures. Most enemies Western armed forces face resemble a basic human archetype. *Warriors* thrive on disorder, and any confrontation with order makes them shrivel. They have no stake in peace and see no advantage in the status quo.[24] The waves indicate that new styles of war might emerge, but they coexist with old and almost extinct ones. The most striking paradox of the Third Wave is that unlike earlier waves, the outdated, the poor and the obsolete can defeat a strategy that exploits all the means advanced technology and analytical skills can offer. The Third Wave seems to end an era of traditional wars in which the actual use of military force was the central element of statecraft. We witness mixed wars in which both non-military instruments of national power and the non-traditional use of the military force are dominant.[25] For much of the world's population, fighting wars and living as warriors is a step up rather than a step down. The old rules of interstate warfare do not apply to them as they fight for shadowy and loose organisations requiring a tribal-like identity, rather than any form of citizenship. Fighting asymmetric and unconventional wars means that we face an enemy who is less disciplined, more spontaneous and resembles attributes of criminal gangs. This mix makes it extraordinarily hard to achieve any sort of decisive victory in traditional terms. At the turn of the 21st century, the warrior is back globally, and as brutal as ever, but better-armed. He prefers to fight asymmetrically without written and customary rules. War provides him with leisure, wealth, recognition and camaraderie. He wages wars for their own sake, interwoven with various moral and religious ideas. Consequently, wars will become more flexible, more mobile and filled with tacit elements. Decreasing temporal and spatial limitations indicate that fighting warriors can become virtual from a technological point of view, and bodiless from a military point of view. Thus traditional advantages of Western armed forces may be negated.[26]

Research Framework

After the collapse of the Soviet Union armed forces had to refocus from fighting possible major theatre wars to operations that have little similarity with traditional war-fighting. Most military operations in the 1990s such as Somalia and the Balkans were aimed at fighting irregular forces, including warlords and various criminal gangs. However, after the turn of the millennium armed forces had to once again re-adjust. The terrorist attacks on the World Trade Centre in

---

[23] Huntington, Samuel: *The Clash of Civilizations?,* Foreign Affairs, Summer 1993, pp. 22-49; Handel, Michael I.: *Clausewitz and the Age of Technology,* in: Handel, Michael I. (ed.): *Clausewitz and Modern Strategy,* Frank Cass, 1986, pp. 82, 85; Tomes, Robert R.: *Relearning Counterinsurgency Warfare,* Parameters, Spring 2004, pp. 16-28.

[24] Chisholm, Donald: *The Risk of Optimism in the Conduct of War,* Parameters, Winter 2003/04, p. 115; Peters, Ralph: *Our New Old Enemies,* Parameters, Summer 1999, pp. 22-37; See Josephus: *The Jewish War,* Penguin Books, 1959, pp. 263-339.

[25] Tucker, David: *Fighting Barbarians,* Parameters, Summer 1998, pp. 69-72; Foster, Gregory D.: *The Postmodern Military, The Irony of "Strengthening" Defense,* Harvard International Review, Summer 2001, pp. 24-25.

[26] Ehrenreich, Barbara: *Blood Rites: Origins and History of the Passions of War*, Metropolitan Books, 1997, p. 227; Kaplan (1994), pp. 72-74; Gilbert, in: Peters (ed.), p. 15; Peters, Ralph: *The New Warrior Class,* Parameters, Summer 1994, pp. 16-26; Peters, Ralph: *The Culture of Future Conflict,* Parameters, Winter 1995-96, pp. 18-25; Gray, Colin S.: *Weapons for Strategic Effect, How Important is Technology?,* Occasional Paper Number 21, Center for Strategy and Technology, Air War College, Air University, January 2001, pp. 3-15, 31-36.

September 2001 made it clear that Western armed forces need to go through a very thorough transformation if they want to address the challenges of an increasingly fluid and difficult-to-decode global environment. As the military operations in Afghanistan and Iraq showed, most NATO countries did not possess adequate capabilities and could not respond to the missions as desired.[27] The 2002 Prague Summit called for a thorough transformation process with more balanced and effective military capabilities. NATO must be able to send forces on short notice, and sustain operations over distance and time even in environments in which nuclear, biological and chemical threats are likely. The summit also ended an old and painful out-of-area debate within the Alliance by stating that NATO forces must become able to operate outside Europe.[28] The emphasis moved to more mobile and swiftly deployable forces, more special operations forces, better precision strike capabilities and modernized command structures. The participating heads of states and governments also called for a program on specific, near-term capability improvements. Instead of attempting to sustain interoperability across the full spectrum, they emphasised the importance of creating niches of excellence in critical combat shortfalls. Proposals included areas such as defending against chemical, biological, radiological and nuclear attacks; ensuring command, control and information superiority; improving interoperability of deployed forces and key aspects of combat effectiveness; and ensuring rapid deployment and sustainment of combat forces. NATO defined the areas of adaptation in order to become able to perform fundamental security tasks and to carry out the full spectrum of operations more effectively.[29] Two interrelated concepts were born in Prague, both allowing for reductions in infrastructure and offering the advantage to carry more capabilities:

- The first emphasises *expeditionary capabilities* and means that future armed forces must be able to project power over a large distance without limitations regarding sustainability.
- The second emphasises *modularity*, which means that national militaries must posses a structure that enables a smooth rotation among national and co-operation between various international force elements.[30]

Although the Declaration outlined the framework in general terms, the way ahead still appears to be vague as NATO faces a bewildering array of threats. Combating various sorts of irregular forces poses a serious challenge, which cannot be approached in traditional terms based on sustained focus and predictable scenarios. Attempts to address this complexity of tasks resulted

---

[27] Fact Sheet: *NATO: Building New Capabilities for New Challenges*, The White House Office of the Press Secretary, For Immediate Release, 21 November 2002, Internet, accessed 16. 09. 2004, available at www.usinfo.state.gov/topical/pol/nato/02112111.htm.

[28] *Prague Summit Declaration*, NATO Press Release 127, 21 November 2002, Internet, accessed 12. 04. 2004, available at www.nato.int/docu/pr/2002/p-127e.htm; *The Transformation of NATO*, Opening speech by President of the Czech Republic, Vaclav Havel at the Conference organised by Host Committee and the Aspen Institute of Berlin, 20 November 2002, Internet, accessed 16. 09. 2004, available at www.nato.int./docu/speech/2002/s021120c.htm.

[29] *Remarks by the President of the United States, George W. Bush to the Atlantic Student Summit*, 20 November 2002, Internet, accessed 20. 11. 2004, available at www.nato.int./docu/speech/2002/s021120f.htm; *The United Kingdom Delegation to NATO*, Prague Capabilities Commitment, 11 July 2003, Internet, accessed 20. 08. 2004, available at www.nato.int/uk/docu/capa2.htm.

[30] Cebrowski, Arthur: *Planning a Revolution: Mapping the Pentagon's Transformation,* a lecture presented to the Heritage Foundation on 13 May 2003, Internet, accessed 18. 05. 2003, available at www.heritage.org/Research/NationalSecurity/wm292.cfm.

in many competing force employment theories from which effects-based operations or the *effects-based approach to operations* has become dominant. The central tenet of which is that operations must be guided first and foremost by *desired effects* achieved on the enemy. The Quadrennial Defense Review issued by the Department of Defense in 2006 emphasises explicitly the need to make the shift "[f]rom massing forces – to massing effects" and "[f]rom focusing on inputs (effort) to tracking outputs (results)."[31] NATO officials also state that the effects-based approach represents "a new and innovative way of looking at battlefield operations" and allows for putting "military operations … into a wider context".[32] Undoubtedly, most publications detailing the concept read like a hosanna and praise the incredible potential and advantages of effects-based operations. Among others it is claimed that wars can be won cheaply in terms of money and men. It is also stated that wars can be waged without involving large scale destruction in traditional terms. Focusing on desired effects makes possible to control the enemy, thus shortening the duration of conflicts. During recent effects-based exercises, officials claimed that the concept represents "a fundamental way of thinking that focuses on the efficient and effective achievement of desired effects in the operational environment, vice a primary focus on the completion of assigned tasks."[33]

Research Question

In sum, effects-based operations or the effects-based approach to operations seem to offer an excellent framework for the full range of possible missions for three simple reasons:

- *Comprehensive* – it is not domain-specific since it includes both lethal/non-lethal and kinetic/non-kinetic application of force. Thinking in terms of effects is a comprehensive approach that does not rely solely on technology, precision strike, air power or any other 21st century war-fighting tool.
- *Coherent* – it stands for a broad view that transcends service boundaries and offers a coherent framework for various force planning activities.[34] The concept makes it easier to find unequivocal metrics that quantify the justifications in strategic planning, force structure and budgets.

---

[31] *Analyzing Effects-Based Operations*, Workshop Report 29-31 January2002, MORS, 2 January 2003, Internet, accessed 24. 12. 2005, available at http://www.mors.org/publications/reports/EBO_Report.pdf; Quotation in Department of Defense: *The 2006 Quadrennial Defense Review Report,* 6 February 2006, pp. v-ix, 5; Skinner, Tony: *NATO endorses effects-based approach*, Jane's Defence Weekly, 26 April 2006, p. 5.

[32] Quotation in Huval, Joel: *Exercise Allied Reach 2005 Concludes, SACT introduces Effects-Based Approach to operations during exercise in Norway*, ACT Public Information Office, 15 February 2005, Internet, accessed 21. 02. 2006, available at www.act.nato.int/multimedia/articles/2005/021505jwcar05.htm.

[33] Quotation in Barnes, Marvin: *Effects-based concepts face test in Turkey*, ACT Operational Experimentation, 14 February 2006, Internet, accessed 21. 02. 2006, available at www.act.nato.int/multimedia/articles/2006/060214mne4.html.

[34] Mann, Edward (Col.)/Endersby, Gary (Lt.Col.)/Searle, Tom: *Dominant Effects: Effects-Based Joint Operations,* Aerospace Power Journal, Fall 2001, Internet, accessed 27. 09. 2002, available at www.airpower.maxwell.af.mil/airchronicles/apj/apj01/fal01/vorfal01.html; Williams, Brett T. (Col.): *Effects-Based Operations: Theory, Application and the Role of Airpower,* U.S. Army War College, Carlisle Barracks, 09 April 2002, pp. 6-12.

- *Human* – it accords with the wide-spread assumption that modern warfare has become so debated in the more economically developed societies that large, bloody campaigns are regarded as a thing of the past, and not tolerated by the majority of the population and the world population.[35]

The assumed advantages of effects-based operations have put the concept into the centre of discussions regarding the proper employment of force. Effects-based operations put unilateral emphasis on outputs articulated as effects in which exploiting causal relationships play a great role. However, war appears to be a paradoxical activity as it is composed of constant, universal, and inherent qualities such as violence and chance – all pointing towards uncertainty.[36] Due to the contradiction between the concept's focus on causality, and the uncertain nature of war the research question is: ***To what extent is it possible to focus on causal relationships in an uncertain and violent phenomenon such as war?*** The relevance of the research question is supported by the fact that despite the overwhelming popularity of the effects-based approach, we found inconsistency and dangerous simplifications regarding the nature of war. The concept displays war as a process that can be waged in a clinically clean manner by focusing only on the ends in terms of carefully selected desired effects. We have the impression that with effects-based operations, the proverbial frictional mechanism of war as outlined by Clausewitz can be solved through analysis and deduction.[37] Given this contradiction to the traditional Clausewitzian school of thought regarding war's nature, the thesis functions to elaborate on the difference. It uses effects-based operations as basis for reflection on Clausewitz's eternal work *On War*, especially those parts in which he elaborates on friction and the way causal relationships develop. The literature survey on effects-based operations in 2002/2003 made it clear that the concept rests only on scattered approaches, but there was no general theory available. Scientific examination however, requires a general theory at hand. In fact, constructing a general theory of effects-based operations offers many advantages. It promotes the systematic study and an analysis in broader terms. It makes possible to identify the concept's origins in the form of similar theories and allows for the systematic search and detection of hidden or obvious inconsistencies within the theory. The elimination of detected and identified inconsistencies makes it possible to upgrade the existing theory, and allows for generalisations to give the theory a certain normative power. Only through the elaboration of a general theory of effects-based operations can we make a direct comparison between the frictional mechanism of war as outlined by Clausewitz, and the analytically solvable causality-focused mechanism of effects-based operations.

Research Design

The thesis can be seen as a descriptive, reflective and explanatory study. It is descriptive in a sense that it describes effects-based operations and the way the concept is widely advocated. It

---

[35] Lynch, Hugh: *The Changing Character of Warfare*, Internet, accessed 22. 08. 2005, available at www.nwc.navy.mil/srd/Documents/Changing%20Character%20report.htm.

[36] Sheehan, Mike: *The Changing Character of War*, in Baylis, John/Smith, Steve/Owens, Patricia (eds.): *The Globalisation of World Politics*, Oxford University Press, 2007, pp. 213, 216; Kolenda D. Christopher (Maj.): *Uncertainty in War: Exploring the Nature of Combat and Conflict*, Advanced Research Project, Naval War College, February 2002, pp. 46-56.

[37] Clausewitz, pp. 138-142.

is also reflective since by evaluating the theory in terms of consistency and coherence we use *On War* as its basis. It is explanatory since inconsistencies are discovered we identify and explain the contributory factors in detail. The thesis consists of three parts and aims at developing a coherent framework that departs from effects-based operations and details the nature of cause-and-effect relationships in war.

Part One – Constructing the Theory

The first part of the thesis can be seen as a theoretical framework. In **Chapter 1** we systematise various approaches to effects-based operations in order to establish a general theory. For this reason we introduce seven publications that can be seen as most fundamental in the discussion of effects-based operations. It was our decision to use sources that had been completed before the official beginning of the research in March 2003. **Chapter 2** details the evolution of the concept and the way how it has penetrated up to the highest echelons of American political-military leadership. For this reason the contents of fundamental documents such as the Defence Reviews and the Joint Visions are explored in detail. The first mixed reactions of the services to effects-based operations are also introduced here. Based on the comparative analysis of the publications in **Chapter 3** we construct a general theory of effects-based operations based on common elements and characteristics. The three common elements of effects-based operations such as effects-focus, advanced technology and systems thinking, are central to the thesis. This chapter also puts effects-based operations into a metaphysical framework in order to discuss the problem of cause-and-effect relationship in detail. **Chapter 4** addresses an interesting aspect of effects-based operations: most publications mention that the concept is not new as successful commanders through all ages have already applied some sort effects-based operations. Based on the three common elements identified we can examine the truth behind such assumptions. Serving as a vehicle for content analysis, the three common elements help explore the works of past significant military theorists such as *Sun Tzu*, *Machiavelli*, *Jomini*, and Clausewitz. This content analysis aims at detecting to what extent their works contain references to effects-focus, advanced technology and systems thinking. Another benefit of a general theory of effects-based operations is displayed in **Chapter 5**. The three common elements and the characteristics help us relate effect-based operations to similar force employment theories. Most air power theories advocating military coercion share obvious similarities with the common elements and characteristics of effects-based operations. In a similar way also they focus on achieving effects on the enemy, advocate the application of advanced technology in war, and rest on systems thinking that dissect the enemy into various analytic categories. In **Chapter 6** we introduce two classical schools of military coercion, punishment standing for large-scale aerial bombing and risk, which represents the nuclear weapon and the effects it generate. Here we also explain in detail to what extent the theories worked in reality. **Chapter 7** contains two more sophisticated schools of military coercion such as decapitation, which can be seen as a direct origin of effects-based operations. Denial, the other school, advocates a joint approach to employing force and is also more in lieu with the Clausewitzian frictional nature of war. The chapter ends with an interim conclusion in order to make a smooth transition into the next passage.

Part Two – Reflecting the Theory

The first part revealed that despite the increased complexity of challenges, the multitude of players and motives involved the three common elements of effects-based operations accord

with the inherent Western bias to war. Thus it is seen in terms of causal linkages between actions and outcomes in which the strategic is emphasised over the tactical. Advanced technology is put first, and the human dimension second. The whole is regarded and the particular mostly neglected. Despite the frequent reference to Clausewitz, war is addressed mostly in analytic terms in which combat is seen as a rational activity. The second part of the thesis reflects the general theory of effects-based operations on a background, which can best be described by friction as outlined by Clausewitz. **Chapter 8** first elaborates more on the mechanism of denial in order to examine war's proverbial friction in detail. It also identifies the very sources of friction to put it into a contemporary context. In **Chapter 9** we deliver an explanation for the preference to use scientific principles and analytic explanations for complex real-world phenomena. We also detail the relationship between friction and unpredictability together with consequences such as incompleteness and instability. In **Chapter 10** we use a structural analysis to better understand the attributes of causality. The explanatory framework set in this chapter explains the various sorts of relationships that exist between input and output, causes and effects in war. The four types of relationships are identified as simple, complicated, complex and chaotic, and reveal war to be a *complex adaptive system* in which unpredictability reigns. Complex adaptive system demands war to be seen in an organic framework, which is detailed in **Chapter 11**. An organic approach shares similarity with biological evolution for which it appears to be a useful metaphor for examining war. The military has always loved metaphors as frames of reference for facilitating discussion and developing ideas. In **Chapter 12** we use Clausewitz's *Dynamic Law in War*, which helps us see war in an evolutionary framework. As a tool, we employ a metaphor commonly known as the *fitness landscape*. It is an approach that has both heuristic and analytical values, and can visualise properties of real-world phenomena by means of statistical features. **Chapter 13** outlines our approach to conceptualise effects-based operations in an evolutionary framework. The proposed *effects landscape* allows us to see effects-based operations as a high-dimensional search process that seeks to identify an optimum combination of effects, in order to occupy high spots on the landscape. Part two also contains an interim conclusion, which leads us to the last part of the thesis.

Part Three – Applying the Theory

The evolutionary framework we proposed in part two helps us understand the underlying mechanism of war's proverbial friction and unpredictability, which both work against the three common elements of effects-based operations. However, using the vocabulary of any given scientific field requires that we take all its theoretical and practical consequences into account with equanimity. For this reason, **Chapter 14** examines the consequences of our evolutionary approach in terms of strategy development. Here we contrast the traditional military approach to strategy, which emphasises thorough planning on all levels with an approach that is more organic and open, thus taking the unpredictability of war into its proper context. We suggest war to be seen as an *Organic Strategic Ecosystem*. In **Chapter 15** we examine in a similar fashion, the consequences of our evolutionary approach for command and control. The biological analogy of war helps us propose command-by-evolution, which is in accordance with the constantly changing character of war. In **Chapter 16** we examine the issue of military effectiveness from a biological perspective. It demonstrates that regardless of the manner in which effectiveness is approached, we have to deal with a multitude of factors. Any attempt to

get a grip on the issue of military effectiveness means that practical benefits go together with a certain analytical convenience. **Chapter 17** concludes with the findings of our research.

Third Wave and Effects

The research made it clear that war is a conflict laden task full of temporal and spatial constraints in which it is very difficult to strive towards predefined objectives and desired effects. The attacks on 9/11 made also clear that constructs capitalising on traditional responses can run the risk of being costly, slow and unnecessarily destructive. Terrorist organisations herald a new type of asymmetrical and unconventional enemy, who is capable of confronting the West on a global scale. By being dispersed and avoiding decisive engagements, he continually takes advantage of the globalised world.[38] Whereas the West still relies on overwhelming force based on technological sophistication, terrorist organisations use intellectual capital and successfully discover vulnerable niches. The most important consequence of such asymmetry is that there is "an increasing disparity between [the] traditional vision of a "kinetic kill" and the remaining effects to be achieved."[39] In a similar fashion, war conceptualised in an evolutionary framework suggests a phenomenon in which both sides are simultaneously attacking and defending. The aim is not so much to seek a direct head-on annihilation, but to cause confusion through constant learning and adaptation. In other words, success comes as the result of quick and fluid movements rather than achieving desired effects. The evolutionary analogy emphasizes improvisation, which is based on bottom-up local knowledge often without any direct assistance from the top. Planning, which is at the very heart of effects-based operations, is important, but not too important or detailed. Seeing war this way requires loosely organised, fairly autonomous and dispersed units that often carry out individual actions in an unsynchronised way. Consequently, war is an interactive process requiring continual effort and commitment over a long period of time. Effects-based operations stand for synergy of capabilities with a focus on achieving various types of desired effects on the enemy. Thus the concept indicates the possibility to synchronise all available means in order to achieve desired outcomes at all levels of war. Consequently, at least in theory it offers a good framework for confronting one's advisaries.[40] However, the thesis indicates that the three common elements such as effects-focus, advanced technology and systems thinking stand in sharp contrast not only with the attributes of the Third Wave, but also with war's frictional and unpredictable nature. Both work against the possibility to detect exploitable causal links in order to achieve quick and affordable victories.

---

[38] Pendall, David P. (Maj.): *Effects-Based Operations and the Exercise of National Power,* Military Review, January-February 2004, pp. 20-21.

[39] Quotation in Read, Robyn: *Effects-Based Airpower for Small Wars,* Air & Space Power Journal, Spring 2005, Internet, accessed 17. 08. 2005, available at www.airpower.maxwell.af.mil/airchronicles/apj/apj05/spr05/read.html; See also Toffler/Toffler, pp. 69-80; Dunlap, Charles J. (Jr.): *21st Century Land Warfare: Four Dangerous Myths,* Parameters, Autumn 1997, pp. 27-37; Chisholm, Donald: *The Risk of Optimism in the Conduct of War,* Parameters, Winter 2003/04, pp. 114-131.

[40] McCrabb, Maris "Buster" Dr./Caroli Joseph A.: *Behavioral Modeling and Wargaming for Effects-Based Operations,* Internet, accessed 14. 05. 2003, available at www.mors.org/meetings/ebo/ebo_reads/McCrabb_Caroli.pdf.

Effects Focus

The focus on effects indicates that we can take advantage of direct causality in war. Effects-based operations emphasise the ability to directly translate strategic objectives into tactical actions. Simple causal mental constructs are always helpful in guiding the decision-making process. However, as soon as wars start, plans evolve very rapidly and become fluid. Military activities have a dynamic nature and are shaped by changing tactical actions, which defy most assumption regarding direct causality.[41] Direct causal relationships aimed at achieving desired effects assume a certain continuity or stability in terms of objectives. Clausewitz warned the the "original political objects can greatly alter during the course of the war and may finally change entirely since they are influenced by events and their probable consequences".[42] Deductive thinking can be helpful and iterative cycles might help optimise for achieving desired effects. In case the enemy is a nation state, which depends on a well-developed, modern and vulnerable infrastructure, the search for direct causality aimed at certain leverage points might make sense. When confronting asymmetric and unconventional enemies, especially terrorist organisations that do not possess such attributes, relying on an exclusively deductive strategy as basis for actions is both time-consuming and does not address the dynamic and fluid character of challenges.[43]

Advanced Technology

The second common element concerns enabling technology, which often reflects unproven and optimistic assumptions about what they can deliver in war.[44] Although technology advances and opens unprecedented opportunities, it is not yet clear whether it changes war's nature or just its form. Advanced computers, sensors and other data processing tools always coexist with subjective filters as decisions come mostly as a result of individual judgements.[45] Operations aimed at controlling the enemy's will and behaviour might sound better than deferring to blunt destruction, and are more politically palatable. Nevertheless, killing the enemy is sometimes more effective than any careful attempt to influence his mind. We have to acknowledge that

---

41 Cordesman, Anthony H./Burke, Arleigh A.*: Understanding the New "Effects-based" Air War in Iraq,* Center for Strategic and International Studies, 15 March 2003, p. 3, Internet, accessed on 31. 03. 2003, available at www.csis.org/burke/mb/iraq_airwar.pdf.

42 Quotation in Clausewitz, p. 104; Polumbo, Harry D. (Col.): *Effects-based Air Campaign Planning: The Diplomatic Way to solve Air Power's Role in the 21st Century,* Air War College, Air University, Air Force Academy, April 2000, pp. 18-24.

43 Barlow, Jason B. (Maj.): *Strategic Paralysis, An Airpower Theory for the Present,* School of Advanced Airpower Studies, Air University, May 1992, pp. 9, 39-45; Centre of gravity is often a floating concept. See Lee, Seow Hiang (Maj.): *Center of Gravity or Center of Confusion, Understanding the Mistique, Air Command and Staff College,* Air University, Maxwell AFB, Wright Flyer Paper No. 10, December 1999, pp. 7-22.

44 O'Hanlon, Michael: *Technological Change and the Future Warfare,* Brookings Institution Press, 2000, pp. 107-142; Hammes, pp. 190-206. Tenner, Edward: *Why Things Bite Back: Technology and the Revenge of Unintended Consequences,* Alfred A. Knopf Inc., 1996, pp. 3-25.

45 Echevarria, Antulio J. II (Maj.): *War, Politics, and RMA – The Legacy of Clausewitz,* Joint Force Quarterly, Winter 1995/96, pp. 78-79; De Greene states that growing dependence on technology reconfirms the status quo rather than increases effectiveness. De Green, Kenyon B.: *Field-Theoretic Framework for the Interpretation of the Evolution, Instability, Structural Change, and Management of Complex Systems,* in Kiel, L. Douglas/Elliott, Euel (eds.): *Chaos Theory in the Social Sciences, Foundations and Applications,* The University of Michigan Press, 1996, pp. 290-291.

under certain circumstances it is simply not possible to realise psychological end-goals based on influence and control. As the second war in Chechnya displayed, should the enemy have a "deep and persistent antipathy … it will be impossible to achieve victory without a decisive confrontation and military conquest."[46] Thus attrition and annihilation aimed at achieving physical effects still have relevance. In Iraq the enemy prefers asymmetric warfare fought on the tactical level in the form of car-bombs, kidnapping and other sort of assaults and ambushes. Focusing on enemy behaviour on this level of war is often meaningless. The tactical level mostly stands for physical effects in the form of attrition and annihilation, and is fought with blood and gut, but not in abstract terms.

Systems Thinking

The third common element is a systems approach. However, it is still unclear how a mechanical system-of-system understanding that decomposes the enemy into ever finer details, can coexist with a more organic complex adaptive system approach with a holistic focus. There is a difference between thinking in terms of passive complicated systems, or complex systems that have the ability to learn and adapt. Whereas the first allows for a deductive methodology assuming clear boundaries, the latter emphasises unclear and shifting boundaries that require both deduction and induction.[47] According to the mechanistic approach control is possible. Unfortunately, an organic approach in which the enemy is seen as a complex adaptive system is less ambitious and allows only for coping. Effects-based operations indicate the simultaneous application of all means intended for a given action and assume symmetry as the enemy's elements of power are addressed. However, Al Qaeda is the best example that virtual, non-state enemy organisations without traditional elements of power, deny the usability of analytic categories in traditional terms. This problem is often magnified by the fact that the complexity of challenges, even within a single mission, can limit the range of applicable means. Thus armed forces are often constrained and have to adjust to as a part of a larger operation.[48]

---

[46] Burridge, Brian: *Technical Development and Effects Based Operations,* 2004 Trenchard Memorial Lecture, RUSI Journal, October 2004, pp. 26-28; Thomas, Timothy L.: *The Battle of Grozny: Deadly Classroom for Urban Combat,* Parameters, Summer 1999, pp. 87-92 (quotation p. 91).

[47] Smith, Edward A.: *Complexity, Networking and Effects-Based Approaches to Operations*, CCRP Publication Series, May 2006, pp. 36-40.

[48] Clausewitz, p. 241; Alberts (2003), p. 48.

Part One – Constructing the Theory

1 A New Concept is Born

> *"…treat war as a drama that it is rather than constantly reducing it to a science of marching tables and tonnage calculations. I do not decry the necessity for the scientific end of education, I merely think that too many officers develop their thinking more and more along the lines of mathematical calculations rather than realizing that calculations always go wrong."*
>
> *Dwight Eisenhower*

1.1 Effects-Based Operations

The term *effects-based operations* first appeared during the 1991 war against Iraq in which the American-led coalition forces achieved a victory that surprised even the most optimistic analysts. The world, expecting a rather bloody and protracted campaign against Saddam Hussein's armed forces, witnessed a war fought at lightning speed with limited coalition casualties. The incredible potential of advanced technologies such as stealthy platforms and precision weaponry, was in the global media. The new force employment concept emphasised the primer of achieving effects on the enemy and disregarded large-scale destruction. Soon effects-based operations became a buzzword in the military lexicon and synonymous with Western, especially American, technological superiority. Over the years the concept proved so durable that it increasingly permeated military and political thinking. Terms such as *effects-based thinking*, *effects-based targeting*, *effects-based approach*, *effects-based planning*, *effects-based execution* and *effects-based assessment* are almost commonplaces now.[49] Armed forces outside NATO also started to move towards this direction as the Israel Defence Force chief of staff, General Moshe Ya'alon emphasised in an interview. According to him, force transformation issues must focus less on force and power, but more on effect.[50] Most assumptions regarding effects-based operations are promising such as campaigns can be kept short, destruction and casualties limited. Thus effects-based operations make possible to save precious resources. Unfortunately, despite the abundance of publications there is neither a common understanding of the meaning of effects-based operations, nor a widely accepted definition of the term. In order to address this shortcoming, we first introduce seven significant and influential publications representing different approaches. Every publication, regardless its logical and theoretical merit, is assigned equal weight. The introduction of the documents helps us create a detailed taxonomy to understand the characteristics of effects together with the way they interrelate. This comparative

---

[49] ACT identified three objective areas with one focusing on achieving coherent effects. Goals include command for *effective engagement*, *effects-based operations*, and aspects such as *effective engagement* and *joint manoeuvre effects*. See Allied Command Transformation*: Integrated Project Teams,* 7 September 2004, pp. 1-2.

[50] Hughes, Robin: *Interview, Lieutenant General Moshe Ya'alon, Israel Defence Force Chief of Staff,* Jane's Defence Weekly, 17 November 2004, p. 34.

analysis will serve as foundation for us to construct a general theory of effects-based operations in which we can both clarify the meaning of the term and deliver a definition.[51] The documents include papers written by an American Air Force general (USAF), the Research and Development Corporation (RAND), the Institute for Defense Analysis (IDA), the United States Joint Forces Command (USJFCOM), the Command and Control Research Program (CCRP), the Air Combat Command (ACC) and the Air University College of Aerospace Doctrine, Research and Education (AU CADRE).

1.2 Enthusiastic Approach

General Deptula from USAF can be seen as the earliest promoter of effects-based operations. According to him, the successful air campaign of the 1991 Gulf War was the birthplace of the concept. However, effects-based operations are not original since excellent military commanders have always known superior alternatives to attrition. The concept is a methodology, a different way of thinking that capitalises on the causal relationship between action and outcome.[52] Technological superiority in the form of stealth technology and precision guided munitions make it possible to attack more separate targets at once than ever before in history. In effects-based operations, it is not the sheer number of sorties that is important, but the way operations are planned. Instead of focusing on simple and utter destruction of targets, the intention is to achieve specific effects on the enemy. At the core of effects-based operations are simultaneous attacks on high value objects that result in surprise, influence, fewer casualties, paralysis, and controlling the enemy in a shorter time span. Consequently, effects-based operations fully exploit the temporal and spatial dimensions at every level of war.[53] Not destruction, but control, across the breadth and depth of the entire theatre is important. This eradicates the enemy's strategic freedom. Control demonstrates that effects-based operations make it possible to attain security objectives without destruction or visible disruption. In effects-based operations the enemy must be understood as a system-of-systems in which essentials such as leadership, population, industries, transportation, and military forces are affected in order to achieve system ineffectiveness.[54] This requires a high rate of attack that deprives the enemy the ability to adapt or find alternatives. Central to the concept is precise weapons delivery, the relative low number

---

[51] Officially the British prefer the expression *strategic effect of air power*. Ministry of Defence: *British Air Power Doctrine, AP 3000, Third Edition,* Her Majesty's Stationary Office, 1999, pp. 2.6.1-1.6.10; Ho, Joshua: *The Advent of a New Way of War: Theory and Practice of Effects-Based Operations,* Institute of Defence and Strategic Studies, Singapore, December 2003, pp. 5-10.

[52] Deptula, David A. (Brig. Gen.): *Effects-Based Operations: Change in the Nature of Warfare,* Aerospace Education Foundation, Defense and Airpower Series, 1995, p. iii*; A Dialogue on Analyzing Effects Based Operations (EBO),* led by Dr. Jacqueline Henningsen, SES, MORS Fellow of the Society, Director Air Force Studies & Analyses Agency, Internet, accessed 31. 03. 2003, available at www.mors.org/publications/phalanx/mar02/Lead2.htm; Deptula, David A. (Maj. Gen.): *Effects-Based Operations: A US Perspective,* World Defence Systems, The Royal United Services Institute, Volume 6, Number 2, August 2003, p. 37.

[53] Deptula, David A. (Brig. Gen.): *Firing For Effects,* Air Force Magazine, Volume 84, Number 4, April 2001, Internet, accessed 21. 03. 2003, available at www.afa.org/magazine/April2001/0401effects_print.htm.

[54] Deptula (2003), p. 37; Deptula: *Air Force Transformation, Past, Present, and Future,* Aerospace Power Journal, Fall 2001, Internet, accessed 02. 04. 2003, available at www.airpower.maxwell.af.mil/airchronicles/apj/apj01/fal01/phifal01.htm.

of resources needed to suppress enemy air defences, and an operational level force employment concept that focuses on effects. Stealth and precision contribute to the ability to achieve control over parts of the enemy's systems, which leads to paralysis during a specific period. The result is harmony between the efficiency of hitting individual targets and the effectiveness to achieve campaign objectives. This enormous leverage makes the traditional concept of war, focusing on destruction and exhaustion useless. A paralysed enemy equals a destroyed enemy. Important in effects-based operations is the application of a deductive top-down approach in which strategy is decomposed into specific objectives down to specific tasks at the tactical level. This methodology makes it possible to directly relate lowest-level tasks to highest-level objectives.[55] Planning for effects is complex and planners must carefully determine which effect on what system can best contribute to the stated political and military objectives. Although parallel attacks are aimed at all targets in each target system simultaneously, campaigns may involve more than one set of force application. No intelligence delivers perfect information on the enemy, his intentions and attempts. Although effects-based operations reduce the time requirement relative to previous wars, the maturation of certain effects might take a finite, but indeterminate time. Thinking in systemic effects is superior to individual target destruction as it shifts the focus from annexing territory towards controlling deviant behaviour. Effects-based operations stand for a coercive concept that requires the co-ordinated application of all elements of national power in order to force enemy compliance. Applied properly it becomes possible to expand the strategic options, avoid attrition-oriented encounters, and to achieve integrated, specific operational and strategic effects.[56] Unfortunately, General Deptula did not deliver a definition of effects-based operations or a taxonomy to help categorise effects. Jay M. Kreighbaum, a former student of the Air University built on his ideas and developed a detailed taxonomy based on the order of effects, their dimension of time, their intention and the levels of war.[57] Almost all effects start as material ones and produce non-material, second-order effects, thus implying a continuum characterised by physical and psychological effects as end-poles. Physical refers to those first-order, direct effects that result immediately after an action and equal physical destruction. These effects possess a strong physical component and are associated with affecting the enemy's war-making capability. Second-order, indirect effects, are downstream results of first-order effects and have some sort of systemic or psychological influence that can either be within a system or between systems. Systemic effects can also be seen as functional effects that disrupt a specific system or systems. Psychological effects attempt to affect the will of the enemy and require mostly an indirect approach. Regarding the temporal qualities of effects, they vary in time as their influence depends on the duration needed to mature. Whereas direct physical effects at the tactical level have a short life-span, effects desired on the strategic level need more time to mature, and have a longer life-span. Despite the planned intent, actions can result both in intended and unintended effects, which can either be adverse, neutral or supportive to the original intent.[58] In terms of properties there are strategic, operational and tactical level effects:

---

[55] Deptula (1995), pp. 3-6, 7-10; Deptula (2003), pp. 39-40.

[56] Deptula (1995), pp. 15-16.

[57] Kreighbaum, Jay M. (Maj.): *Force Application Planning: A System-and-Effects-Based Approach,* School of Advanced Air Power Studies, Air University, June 1998, pp. 74-78.

[58] Ibid., pp. 78-82.

- Strategic effects influence the war as a whole by affecting major functional areas such as war-will and war-sustainment. They require considerable time to mature and have a long duration.
- Operational effects refer to campaigns and major operations. They influence functional areas such as war sustainment and war making. These effects are intermediate in terms of maturation, influence and duration.
- Tactical effects deal with individual battles and engagements. They influence the war-making capability since their generation, maturation and influence is rather short.[59]

1.3 Analytic Challenge Approach

Paul K. Davis from RAND emphasises that effects-based operations are not new, as successful commanders of the past, have also striven for objectives and related effects. The origins of the concept are rooted in the revolt of the war-fighting community against two interrelated failures.[60] The first is the poor force employment strategies of past wars, which focused on servicing targets. The war against Iraq was the first major war in which joint fires resulted in decisive effectiveness on enemy systems. Thus origins of effects-based operations can be found as much in the work of air power theorists as in the modern U.S. manoeuvre theory of the 1980's. The second failure comes from poor standard models and analytical tools, which focus on simple *number crunching* and do not accord with battlefield reality. As inappropriately structured conceptions they rest on an inadequate mechanistic view of warfare, and ignore important soft factors such as will and cohesion.[61] Effects-based operations require a much broader approach and a more realistic analytical toolset. The concept does not focus ultimately on traditional considerations since it emphasises aspects such as collapsing the will and unit cohesion, and defeating enemy strategy. Enablers are qualities such as speed, agility, parallel warfare, decisiveness, and shock and awe. Despite the promises of effects-based operations, war also stands for attrition, destruction and occupation, all indicating that the more traditional aspects of war fighting cannot be excluded entirely. Although the valid essence of effects-based operations is the *systemic view* and the focus on desired effects, a certain amount of attrition and annihilation, and the occupation of territory cannot be ruled out entirely. Consequently, some of the most decisive military operations might still be personal and up-close experiences. Effects-based operations have physical and behavioural aspects, but further distinctions can be based on networking, the character of the target system, timescale and the levels of the conflict.[62] Whereas physical aspects include the disruption of enemy manoeuvre, damaging enemy assets and killing enemy personnel, behavioural aspects aim at demoralising fighting capability, slowing down enemy actions, confusing and deceiving enemy commanders and influencing the decision-making process. The high-goals of effects-based operations focus on the cognitive domain, the decision-making process of political and military key personnel, or an entire population. Nevertheless, a strong re-calibration in terms of common sense is important. It has always been

---

[59] Ibid., pp. 85-88.

[60] Davis, Paul K.: *Effects Based Operations (EBO): A Grand Challenge for the Analytical Community,* RAND MR-1477, 2001, pp. 1-3.

[61] Ibid., pp. 4-8.

[62] Ibid., pp. 11-18.

difficult to understand and model enemy leaders on the strategic level, and in most cases there are no vulnerable elements at the operational level that can be attacked successfully. Human activities occur in complex adaptive systems, which often behave in unpredictable ways. The enemy has attributes that are observable only indirectly and after a certain time delay. Cause-and-effect relationships are influenced by numerous internal and external factors for which there is never a single discernible variable on hand. Davis' definition of effects-based operations emphasises the importance of probability as such operations are "conceived and planned in a systems framework that considers the full range of direct, indirect, and cascading effects, which may – with different degrees of probability – be achieved by the application of military, diplomatic, psychological and economic instruments."[63] Consequently, effects-based operations require changes in the current mindset concerning conflicts and war. New theories and methods are needed, together with a new empirical base in order to improve existing analysis and modelling tools.[64] In terms of taxonomy Davis did not define an effect, but gave a simple taxonomy that describes effects in a hierarchical order. Thus effects can either be physical or behavioural in nature. Further distinctions can rest on duration, level, and type. In terms of duration, effects can be permanent or temporary as they can last for the course of a war, an operation, or a task. Their level mirrors the traditional hierarchy of war as effects can occur on strategic, operational, tactical, and engagement levels. The type of effect can be direct physical, systemic and psychological/behavioural.[65]

1.4 Decision Superiority Approach

For Gleeson et. al. from IDA, effects-based operations produce desired futures with a focus on the entire continuum and not just the conflict itself.[66] The concept makes it possible to exploit the overwhelming amount of data provided by advanced information, surveillance and reconnaissance technology. It means winning both war and peace, in which the emphasis is on higher order effects and complex adaptive systems. Effects-based operations make it possible to focus on operations more coherently, by exploiting the potential of new technologies and capabilities such as stealth, precision munitions and information operations.[67] The concept stands for assessment and adaptation at every level of warfare, and the involvement of all elements of national power. Thus effects-based operations explicitly and comprehensively link actions with outcomes at all levels of a conflict. Although fog and friction of war can never be eliminated, effects-based operations make it possible to learn how to work with uncertainty, ambiguity and risk. The concept requires a clear linkage between strategic outcomes, desired effects and tactical actions, in which military actions must be consistent with, and complementary to the stated political, diplomatic and economic goals. A successful co-operation and co-ordination across all elements of national power direct the focus from the traditional attrition-

---

63 Quotation in ibid., p. 26.

64 Ibid., pp. 7, 21-28, 79.

65 Ibid., pp. 17-19.

66 Gleeson, Dennis J./Linde Gwen (Col.)/McGrath, Kathleen/Murphy, Adrianne J./Murray, Williamson/O'Leary, Tom/Resnick, Joel B.: *New Perspectives on Effects-Based Operations: Annotated Briefing,* Institute for Defense Analyses, Joint Advance Warfighting Program, June 2001, p. 2.

67 Ibid., pp. 2-5.

oriented warfare, and enable a more efficient and focused employment of force. Effects-based operations rest on rich interactions between operational level commanders and other key actors in a campaign. Centres of knowledge can enable an understanding of the strategic and operational environment, the possible effects and their impact, and suggest ways to assess and reassess the enemy. Effects-based operations stand for a continuous process similar to the classical *observe-orient-decide-act loop* as outlined by Boyd, but the concept's strategic focus makes the loop broader and deeper in terms of effects and time. The concept can be seen as a mixture that comes from precision engagement, dominant manoeuvre, and information operations in which all elements of friendly national power address all elements of the enemy's national power.[68] Although the concept is extraordinarily difficult and requires hard thinking, capable commanders throughout history have always tried to implement effects-based campaigns. Success in effects-based operations depends on understanding what the enemy values together with his beliefs and cultural motives. Effects-based operations do not lift the fog of war, but exploit information advantages throughout the conflict. An important requirement of effects-based operations is to shed the practices of mirror imaging and the projection of our culture, values and perspectives onto the enemy who always acts in unexpected ways. Effects-based operations also mean that military forces will probably be tasked in a supporting role to other agencies and will be only one element of a national-level effects-based approach. The concept requires the ability to alter and adapt assumptions and rules when confronted with a complex and adaptive enemy on the battlefield. Even perfect effects-based operations will not yield peace, allow conflicts without any drop of blood, or guarantee that wars will be won quickly and easily. The concept, however, can offer campaigns with greater coherence in which victory is achieved faster and cheaper in terms of money and men.[69] For taxonomy, Gleeson et. al. do not deliver a definition of effects, but identify and examine three major categories such as desired, undesired and unexpected:[70]

- Desired effects address either enemy capabilities or decisions in order to change actions, but not will. Desired effects on enemy capabilities depend on the actions taken, and mean that we change the situation and options in a way that they become unfavourable for the enemy. Desired effects on decisions depend on the enemy's reaction and attempt to change his assessment of the situation and the resulting options.
- Undesired effects are easier to recognize than to predict, and can lead to difficult and costly conflict termination. For undesired effects, time plays an important role and may potentially support or hinder a lasting peace.
- Unexpected effects are the result of the fog and friction of war. However, such effects do not always represent problems, but can contribute to new and exploitable opportunities.[71]

The most important aspect of the taxonomy concerns the relationship between effects and time. The assessment and importance of effects can change over time as new trends emerge and

---

[68] Ibid., pp. 6-11; On John Boyd's observe-orient-decide-act loop see more in Osinga, Frans: *Science, Strategy and War, The Strategic Theory of John Boyd,* Eburon Academic Publishers, 2005, pp. 268-279.

[69] Gleeson et. al., pp. 13-15, 24, 36-39.

[70] Ibid., p. 18.

[71] Ibid., pp. 18-20.

various indirect effects occur. Actions that result in planned and desired effects at a particular time can result in different effects later. Whereas some effects can work well together and create synergy, others interfere and negate each other's impact. Planning for effects should be guided by the effort to synchronise the timing of effects with actions. This makes it possible to put pressure on the enemy's decision-making process to make his decisions and actions irrelevant. However, even with the most careful planning uncertainties of any kind will still remain.[72]

1.5 Jointness Approach

Members of the USJFCOM J9, Concepts Department regard effects-based operations as an enabler for the concept of *rapid decisive operations* with far reaching consequences for the conduct of war.[73] Effects-based operations cover the entire spectrum of operations including all levels of war, and require the application of all instruments of national power involving political-military relationships, and various interagency activities. The concept provides a comprehensive insight into enemy capabilities, environment characteristics, and our own strengths and weaknesses.[74] Effects-based operations can be defined as "a process for obtaining a desired strategic outcome or "effect" on the enemy through the synergistic and cumulative application of the full range of military and non-military capabilities at all levels of conflict."[75] The definition emphasises the ability to facilitate desired effects through all available capabilities, assessment of the outcomes and the requirement for rapid adaptation through continuous and iterative planning and execution cycles. The required comprehensive knowledge comes from networked and interrelated expert teams that conduct a systems analysis of the enemy. Desired effects are stated in the commander's intent, which focuses on the cohesion and behaviour of the enemy by causally linking tactical actions to desired strategic objectives. Effects-based operations mean that the full range of capabilities is applied in order to threaten, render useless or destroy things the enemy values most. Technological innovations and analysis tools make it possible to exploit causal linkages between effects and objectives.[76] Effects can be seen as the results of actions that support objectives through causal linkages. Effects-based operations not only provide the institutionalised process of planning and assessment, but acknowledge that a single action can produce more than one effect. Thus effects-based operations require flexibility to consider all potential consequences of the actions taken. There is also a difference between an effect and an objective. Whereas an objective includes only the desired results, an effect can both be undesired and unexpected. Effects are hierarchical in nature and can be characterised by focus, scope, scale, timing and visibility. Although effects can work well together or interfere, they aim at degrading the enemy's decision-making process. Effects-based operations rest on a cohesive picture that includes information on political, military, economic, social, information and infrastructure factors. The concept requires the study of the enemy as a complex adaptive

---

72 Ibid., pp. 21-22.

73 USJFCOM J9: *A Concept Framework for Effects-Based Operations,* White Paper Version 1.0, as of 18. 10. 2001a, p. i.

74 Ibid., pp. 1-4.

75 Quotation in USJFCOM J9: *A Concept for Rapid Decisive Operations,* Whitepaper Version 2.0, as of 22. 08. 2001b, p. 6.

76 USJFCOM J9 (2001a), pp. 5-8.

system with the aim to identify key links and nodes to get a better grip on his war-making and war-fighting ability. This system-of-systems analysis determines the courses of action in order to bring the enemy's behaviour towards the desired end state. Consequently, the focus is on pressure points to constrain and canalise enemy actions.[77] The historical focus in military operations was on direct, first-order effects. Effects-based operations mean that the focus has moved towards follow-on effects and other potential consequences. The concept relates all tactical actions to the overall desired outcome in which effects are traceable back to higher order strategy. Victory in war depends largely on the assessment of actions in order to determine to what extent desired effects have been achieved.[78] Effects-based operations require an understanding of the full spectrum of capabilities that the instruments of national power offer with the aim to modify enemy behaviour. It is important to target the will and perception of the enemy together with the capability of his military forces.[79] As to taxonomy, an effect can be defined as "the physical, functional, or psychological outcome, event, or consequence that results from specific military or non-military actions."[80] Effects can also be characterised in terms of duration, speed and synchronicity. The most important attribute of effects is their hierarchical or nested relationship, which means that they can be either top-level/supporting or cumulative/cascading. The cumulative attribute indicates that not the sum of the effects achieved is important, but rather the synergy achieved through them which is more applicable to the higher levels of war. Cascading stands for the way higher order effects move downward through common and critical nodes of the enemy's system. Effects can work well together if they complement, or amplify each other, or they may interfere, dampen and even cancel out each other's impact. Although effects can be anticipated, the ability to anticipate all effects is beyond human capability.[81] There is a difference between desired, direct and indirect effects. A desired effect can either be physical damage to material or a casualty effect inflicted on personnel. Whereas a damage effect can be light, moderate or severe, a casualty effect can be immediate, prompt or delayed. Direct effects are the immediate, first order consequences of military and non-military actions that can be recognised easily, as there is no intervening event or mechanism between the act and the outcome. Indirect effects may be physical and psychological in nature, but are always delayed, follow-on consequences of actions, and difficult to recognise.[82]

1.6 Network-Centric Approach

Edward A. Smith from CCRP examines the relationship between effects-based operations and network-centric warfare.[83] The latter indicates military operations conducted in a previously unreachable region of the information domain. The result of *network-centric warfare* is a new type of information advantage characterized by significantly improved capabilities for sharing and

---

77 Ibid., pp. 8-11, 12-17.

78 Ibid., pp. 18-22.

79 Ibid., pp. 23-25, 32-37.

80 Ibid., p. 5.

81 Ibid., pp. 5-11.

82 Ibid., Appendix B, pp. 2-3; For operational level effects see USJFCOM J9 (2001b), Appendix A, p. A-4.

83 Smith, Edward. A.: *Effects Based Operations, Applying Network Centric Warfare in Peace, Crisis, and War,* CCRP Publication Series, 2002, p. 1-12.

accessing information. It is widely assumed that network-centric warfare dramatically increases combat power on the tactical and operational levels of war. According to Smith, in an abstract sense network-centric warfare focuses on achieving effects on the enemy. Through the combination of both concepts war-fighting effects can be achieved at a higher operational tempo, which locks-out adversary courses of action. However, this is not entirely new since good generals, admirals and statesmen have successfully applied military force to shape the behaviour of both friends and foes.[84] Effects-based operations represent the ability to alter the enemy's thinking and behaviour through political, economic and military actions. The concept stands for coercion by forcing the enemy to take a certain course of action. Through effects-based operations, it is possible to see military operations as a cohesive political, economic and military effort. Unlike attrition-oriented campaigns that aim at degrading the physical capability of the enemy, effects-based operations aim at achieving psychological effects in the cognitive domain. The goal is to influence the enemy's behaviour to the extent that he does not want to continue with his resistance. Although achieving physical effects will remain a factor in effects-based operations, the true focus is on achieving psychological effects in which destruction is not the central factor or is to be avoided. Effects-based operations can be defined as "coordinated sets of actions directed at shaping the behaviour of friends, neutrals, and foes in peace, crisis, and war".[85] Interactions between stimulus and response motivate the enemy towards a particular behaviour. The easiest way to do this is to destroy certain capabilities through physical actions. Successful effects-based operations rest on a superior knowledge of the enemy and the situation in order to influence the decision-making process. The aim is to disrupt his observe-orient-decide-act loop, which limits the ability to take coherent actions.[86] Consequently, destruction is only important in terms of its impact on the enemy's will and psychology, but not on his physical capabilities. Effects-based operations together with network-centric warfare make possible to create a condition in which the enemy re-observes, re-orients and re-decides continually with the result that he cannot act coherently or cannot act at all. Effects-based operations place a premium on achieving effects on the enemy's decision-making process for which Smith suggests three different approaches:

- The first multiplies the number of opportunities that lead to desired effects since the employment of frequent stimuli increases the chance that these effects will occur at the right time. This however, requires shortening the time needed for our own decision-making in order to multiply our impact on the enemy.
- The second exploits self-synchronisation and shared situation-awareness by launching more numerous, but smaller operations in order to affect the enemy's decision-making cycle.
- The third rests on the multiplication of cycles and the compression of the time needed for the execution. The last two options are analogous with the attack of a bee swarm. Due to the amount of such stimuli, the enemy can no longer act coherently and be driven into shock and chaos.[87]

---

[84] Gartska, John J.: *Network Centric Warfare: An Overview of Emerging Theory*, Joint Staff Directorate for C4 Systems, Internet, accessed 30. 05. 2006, available at http://www.mors.org/publications/phalanx/dec00/feature.htm; Smith, pp. 1-2.

[85] Smith, pp. 103-108 (quotation p. 110).

[86] Ibid., pp. 108-116.

[87] Ibid., pp. 117-133.

Effects-based operations rest on the ability to create situations in which a relatively small application of force results in disproportionate and decisive impacts on the enemy. Operating beyond the enemy's edge of chaos may cause a state of despair in which further resistance appears to be futile.[88] Effects-based operations represent an asymmetric contest in which the forces involved are dissimilar in character and the respective courses of actions are different. Consequently, there may be two edges of chaos that cross each other and produce a second asymmetric zone. This zone can reverse the advantage achieved in the first or common zone of the contest as the enemy is able to define a niche within which he successfully competes. A network-centric force employed in effects-based operations can act as a complex adaptive system with the ability to mass superior effects on the will of the enemy. The result is not only an improvement in combat efficiency, but also an increase in effects-based efficiency.[89] For taxonomy Smith acknowledges that the term *effect* has a destructive meaning, and often implies nearly everything in military research. A more general operational connotation might be helpful in delivering a definition in which an effect can be defined as "a result or impact created by the application of military and other power."[90] The definition includes kinetic and non-kinetic effects, and is equally applicable to physical and psychological/cognitive effects. Effects can also come from military power without the involvement of destruction or the application of other power sources. Effects are cumulative in nature since they interrelate and never appear in a vacuum. Consequently, the ultimate effect is a cumulative overall outcome that rests on various cycles of interactions.[91] Effects are mainly produced by physical actions and fall into two general areas characterised by predominantly physical or psychological attributes. Both sorts of effects alter behaviour in the end, but whereas physical effects work through the application of physical means, psychological effects work by affecting the enemy's cognitive process. Physical effects include destruction, physical attrition and chaos/entropy that incapacitate enemy forces and capabilities. Psychological effects are chaos/entropy, active and passive foreclosure, shock and psychological attrition aimed at the domains of reason and belief. Direct physical effects can provoke a chain of subsequent, indirect events that may eventually change the enemy's behaviour. The initial impact of physical effects can grow and cascade through the enemy, and eventually spread into the psychological dimension. Physical effects can also initiate higher order physical and psychological effects, which again can cascade into even higher order psychological effects.[92]

1.7 Methodology Approach

According to members of ACC effects-based operations are not new, since the concept has always been applied throughout history with various degrees of success.[93] However, even today it is only sporadically discussed in military doctrines and there is no methodology available for a systematic application. Consequently, it is not yet clear how effects and mechanisms relate to

---

88 Ibid., pp. 134-141.

89 Ibid., pp. 145-152.

90 Quotation in ibid., p. 111.

91 Ibid., pp. 110-112, 213-215.

92 Ibid., pp. 256-274, 302-318.

93 Air Combat Command: *Effects-Based Operations*, White Paper, May 2002, p. 1-2.

objectives and strategy. Effects-based operations can be defined as "actions taken against enemy systems designed to achieve specific effects that contribute directly to military and political objectives."[94] The concept is an evolutionary step that takes *objectives-based planning* and the *strategy-to-task* approach further. Although effects-based operations examine the conditions and causal linkages between actions and objectives, it is not the action itself that is important, but the causal linkages that determine whether or not a desired effect is achieved. Thus, the focus in effects-based operations is on follow-on effects, and not on the probability of achieving the desired result as no action creates only one outcome.[95] In effects-based operations target destruction is still important, but only to the extent the destruction contributes to the achievement of various functional, systemic and psychological effects. An effects-based methodology might also mitigate negative collateral outcomes and other unwanted consequences. Although the fog and friction of war cannot be eliminated, a thorough examination of the causal linkages can improve the probability of success. Effects-based operations stand for a much broader approach than sheer military application. The requirement is to link all elements of national power explicitly and comprehensively across the full spectrum of activities. Victory in war comes from the harmony between the effects desired, the consequences of actions, and the means necessary for an assessment of the effects in question. The concept stands less for a conquest based on attrition and annihilation, but more for controlling the enemy's operational level systems and capabilities to limit his options at each level of war. This way it becomes possible to better integrate all elements of national power and exploit the advantage provided by modern technology. The result is less cost in resources and a transformation, which extends far beyond military operations. Although compliance through brute force remains an option to effects-based operations, operations of the 21st century should attempt to influence decisions and change behaviour with measures being systemic and psychological, rather than physical.[96] Complex interactions with the enemy and rapidly changing conditions require a continuous adaptation enabled by an interagency and multidisciplinary approach. A methodology to successfully apply effects-based operations can come from existing joint publications. The emphasis is on tightness in terms of planning, execution, and analysis that flows down from the national strategic to the tactical level. Enemies represent adaptive human organisations in which the challenge is to out-think and out-adapt adversaries. Effects-based operations replace the simple application of military force with the application of all elements of national power in an integrated and focused manner.[97] Although ACC does not provide a detailed taxonomy of effects, the glossary contains a thorough terminology.[98] Thus effects include the full range of outcomes, events or consequences that result from a specific action. The terminology suggests that it is possible to differentiate between intended and unintended effects, and between direct and first-order, and indirect and higher-order effects. Effects can also be cascading, collateral and cumulative depending on the way they penetrate through the

---

94 Quotation in ibid., p. 4.

95 Ibid., pp. 1-9.

96 Ibid., pp. 10-17.

97 Ibid., pp. 18-26.

98 Air Combat Command, 2002, Glossary of Effects Terminology (no page numbers).

enemy's system. Regarding their nature, effects can be physical, functional, systemic and psychological as they appear on the operational and strategic levels of war.[99]

1.8 Success Paradigm Approach

According to Mann et. al. from AU CADRE effects-based operations neither focus on conquest nor represent the displacement of current forms of warfare.[100] The concept can be seen as a refinement of the objectives-based methodology and the strategy-to-task approach. It allows planners to better examine conditions in terms of causality, in order to define the relationship between actions and objectives. Through the application of all elements of national power across the full spectrum of a conflict, effects-based operations explicitly and comprehensively link strategic and operational objectives with tactical actions in a continuous and iterative fashion. Consequently, the focus is on desired effects that help achieve assigned objectives, which indicates a refocus from achieving *pseudo-objectives* like destruction.[101] Effects-based operations span across the full spectrum of political, military and humanitarian engagements. As a systematic approach, effects-based operations focus on outputs instead of inputs by emphasising national goals, and not capabilities or prerequisites of individual services and organisations.[102] The concept is a new paradigm, according to which military actions are an extension of politics and diplomacy. In other words, military efficiency is often sacrificed for political concerns. The U.S. Air Force has always attempted to do effects-based operations, but only piecemeal without recording or codifying the lessons learned through its experiences. In effects-based operations, the destruction of targets is just means to achieve ends since physical destruction is only one desired effect within a wide spectrum. The emphasis is on the output through the application of both lethal and non-lethal means at the tactical level, which result in pre-determined direct and indirect effects at the operational and strategic levels. Due to their dual nature effects ripple and cascade through the enemy system as the effect of any given action may induce further changes. Virtually no part of the enemy system is truly isolated and the cumulative and cascading character of effects means that it becomes increasingly difficult to predict and measure higher-order effects.[103] In the framework of effects-based operations traditional approaches such as attrition and annihilation are specific types of outcomes, which might be useful only in some cases, as the real goal is to achieve high-level psychological effects. Effects-based operations can be defined as "actions taken against enemy systems designed to achieve specific effects that contribute directly to desired military and political outcomes."[104] The definition emphasises the importance of conditions and causal linkages

---

[99] Ibid.

[100] Mann, Edward (Col., Ret.)/Endersby, G. (Lt. Col., Ret.)/Searle, Tom: *Thinking Effects, Effects-Based Methodology for Joint Operations,* College for Aerospace Doctrine, Research and Education, Air University, Maxwell AFB, CADRE Papers No. 15, October 2002, p. 1; Mann, Edward (Col., Ret.)/Endersby, G. (Lt. Col., Ret.)/Searle, Tom: *Dominant Effects: Effects-Based Joint Operations,* Aerospace Power Journal, Fall 2001, Internet, accessed 27. 09. 2002, available at www.airpower.maxwell.af.mil/airchronicles/apj/apj01/vorfal01.html.

[101] Mann et. al. (2002), pp. 1-3; Mann et. al. (2001).

[102] Mann et. al. (2002), pp. 4-6; Mann et. al. (2001).

[103] Mann et. al. (2002), pp. 25-34.

[104] Quotation in Mann et. al. (2001).

through which actions lead to stated objectives. Effects-based operations always mean further asking and accepting unexpected effects in which the emphasis is on the ability to deal with complex interactions, adaptation to changing conditions, and turning initial shortcomings into an advantage. Unfortunately, despite deep roots and the power of effects-based operations, the military has never really attempted to institutionalize a thought process that is needed to ensure adherence to effects-based principles.[105] In terms of taxonomy, effects are inherently complex phenomena and demand an exhaustive and comprehensive categorisation. Effects have a dual nature and can be both causes and results. Effects refer to a full range of outcomes, events or consequences that result from a specific action, and can be categorized either as direct or indirect. Direct effects are those with no intervening effect or mechanism between action and outcome. Such effects are usually immediate and easy to recognise. Indirect effects are triggered by direct effects and have an intermediate consequence or mechanism in between, as such effects are often the cumulative and cascading results of many direct effects. They are generally more difficult to recognise due to the time required for maturation. Both direct and indirect effects can be physical, functional and psychological in nature, although indirect effects may also be systemic. A further distinction rests on the order of effects, and differentiates among first, second and third-order effects. Whereas first order-effects are directly attributable to a certain action both in terms of location and time, second- and third-order effects are only indirectly attributable to their causes.[106] Effects can also be cumulative or cascading. Cumulative effects are the aggregate results of many direct and indirect effects, and refer to how effects flow upward in the hierarchy. Cascading effects refer to how results at higher levels can flow down and influence lower levels of employment. Thus effects have a distributive character as they ripple through the enemy's system. Each successive layer of effects makes any precise prediction and measure increasingly difficult. Higher-order effects tend to be fleeting in character and give room to subjective interpretations. Collateral effects are unintended occurrences of actions, and can be either positive or negative to the original intent. Whereas negative consequences are those direct and indirect effects that cause unwanted damage, injury or casualties, certain positive aspects can generate outcomes that may support the ongoing course of action:

- Physical effects are direct, first-order effects that rest on direct impacts aimed at achieving physical alteration. Their primary purpose is damaging, destroying or disrupting.
- Functional effects can be direct or indirect effects that degrade the general ability of functioning properly.
- Systemic effects are indirect effects and aim at changing certain characteristics of specific systems or a set of systems.
- Psychological effects are those direct or indirect effects that focus on emotions, motives and reasoning in order to influence behaviour.
- There is also a natural linkage between effects, which may vary over time or in degree according to the situations.[107]

---

[105] Mann et. al. (2002), pp. 42-55; Mann et. al. (2001).

[106] Mann et. al., pp. 30-32.

[107] Ibid., pp. 33-36.

Terms such as *levels of employment* or *spectrum of engagement* refer to the traditional levels of conflicts and can serve as a background for tactical, operational and strategic-level effects. Every conflict is interwoven with all sorts of effects that constantly influence each other.[108]

[108] Ibid., pp. 39-42.

2 Mixed Reactions

Most approaches regard effects-based operations as a superior employment of force with the potential to achieve national security-policy goals not only faster and in a more comprehensive fashion, but also with the involvement of fewer resources. For this reason it is important to see to what extent and at what pace the concept expanded into official milestone documents. This chapter traces back the *codification* process of effects-based operations as reflected in the Defense Reviews and the Joint Visions. The first such report was published soon after the 1991 war against Saddam Hussein's armed forces. The chapter further spots reflections of effects-based operations aimed at making the concept *digestible*. For exploring the band-with of reactions, we first introduce a rather sceptical U.S. Army approach detailing the possible shortcomings and weak points of effects-based operations. This will be followed by a more enthusiastic and technology-oriented U.S. Air Force approach. Both can be seen as attempts to check the concept's usefulness in terms of real-world applicability.

2.1 Milestone Documents

The first such document was the *Report on the Bottom-Up Review*. Released in 1993, the report was intended to help mold the strategy, size and shape of future military forces.[109] It was announced two years after the successful air campaign in Iraq. Although it attempted to define strategy, force structure, modernisation and other related areas, only a limited number of effects references can be found. The report contains only general statements such as the ability to respond effectively to crises or the need to operate more effectively with allied forces. There is neither a reference to what desired effects are, nor how they should be achieved. The only aspects mentioned are accurate information on enemy forces, which are the prerequisite for effective military operations and that precision guided munitions can dramatically increase the effectiveness of a fighting force. Airborne re-fuelling of aerial surveillance and control platforms is seen as a contributor of maximum mission effectiveness. Other references are mainly scattered statements, such as the enhancement of military forces increases the effectiveness of power projection, and a certain type of fire control radar system enhances the effectiveness of attack helicopters.[110]

2.1.1 Joint Vision 2010

Issued in 1996, it was meant to be a conceptual template to achieve new levels of effectiveness in joint war-fighting.[111] As General John M. Shalikashvili, Chairman of the Joint Chiefs of Staff remarked, Joint Vision 2010 was aimed at providing a benchmark for the evolution of the Armed Forces in order to meet the requirements of a challenging and uncertain future. According to it, commanders are expected to create forces that can produce immediate effects leading to desired results. The document also emphasises the importance of advances in target-effect

---

[109] Department of Defense: *Report on the Bottom-Up Review,* October 1993, Internet, accessed 19. 05. 2003, available at www.fas.org/man/docs/bur/index.html.

[110] Ibid.

[111] Joint Chiefs of Staff: *Joint Vision 2010,* July 1996, p. 1.

technologies that produce a broader range of weapons effects.[112] Regarding the conduct of joint operations there is a shift from the traditional concept of massing forces towards massing desired effects. Effects of mass equal the concentration of combat power at decisive time and place that will be achieved with less force than in the past. As Joint Vision 2010 states, the ability to produce desired effects rests on the correct mix of assets and capabilities, which is enhanced by the enormous potential of advanced technology.[113] For power projection, it proposes four new operational concepts such as dominant manoeuvre, precision engagement, full-dimensional protection and focused logistics:

- Dominant manoeuvre is defined as the application of overwhelming force to combine joint combat power more effectively.
- Precision engagement reflects the ability to generate and deliver desired effects from an extended range in order to lessen the risk to friendly forces and minimize collateral damage.
- Full-dimensional protection enables the effective employment of forces while denying the same to the enemy.
- Focused logistics is aimed at directly delivering tailored packages of logistics and sustainment at all levels of operations. These four new concepts result in *full spectrum dominance* and massed effects in the full range of military operations.[114]

2.1.2 Report of the Quadrennial Defense Review

Released in 1997, it went much further into an effects-based direction. The report comprehended the nature of threats and devised appropriate strategies and programs to defuse or defeat them.[115] It also attempted to separate fact from fiction, and purge antiquated assumptions from current realities in order to prepare the U.S. armed forces for an uncertain future. It speaks about new operational concepts and organisational arrangements aimed at enabling joint forces to achieve new levels of effectiveness in conflicts. In reference to Joint Vision 2010, the report understands precision engagement as the ability to deliver desired effects at the right time and place. Focused logistics is seen as the effective delivery of sustainment packages, which result in the overall effect of reduced logistics support. As for the Army the document mentions the effects of increased mobility, lethality and manoeuvre. In reference to the Air Force, it highlights the ability to achieve desired effects with a minimum of risk and collateral damage. For the Navy, it emphasises that network-centric warfare significantly enables the services to achieve enhanced massed effects. There is further shift towards an effects-based direction: whereas the 1993 report speaks of an *effective deterrent* in the form of nuclear forces, this document uses the term *deterrent effect* when referring to the ability to respond to crises as they develop.[116]

---

[112] Ibid., pp. 8-12.

[113] Ibid., pp. 17-19.

[114] Ibid., pp. 20-25.

[115] Department of Defense: *Report of the Quadrennial Defense Review,* May 1997, Internet, accessed 19. 05. 2003, available at www.fas.org/man/docs/qdr/msg.html.

[116] Ibid.

2.1.3 Joint Vision 2020

Issued in 2000, it states that the most effective force must possess full jointness in intellectual, operational, organisational, doctrinal and technical terms in order to make new technologies work. It expands on the conceptual template established by Joint Vision 2010 to guide the force transformation process with the overall goal to create a force that can be dominant across the full spectrum of military operations.[117] Full spectrum dominance, with the four operational concepts as enablers are retained. Only information superiority is extended and seen as the pivotal factor that gives competitive advantage over the enemy if effectively translated into knowledge and decisions:[118]

- Dominant manoeuvre now rests on the capability to scale and mass forces or force itself and the effects of fires as required in the operational theatre. Potential and actual effects result in control of the battlefield at the right time and place.
- Precision engagement is further refined and understood as *effects-based engagement*, which is seen as relevant to all sorts of operations. Linking sensors with kinetic and non-kinetic delivery systems provides the commander with desired lethal or non-lethal effects that support campaign objectives.
- Focused logistics is seen as the effective link between the operator and the logistician in all logistics functions with the result that operational effectiveness and efficiency increases.
- Full dimensional protection is understood as an integrated architecture that effectively manages risks to the joint force and its assets, and results in increased freedom of action and better protection at every level.[119]

A further enabler of full spectrum dominance is the extended concept of information operations in which desired effects and required actions serve as variables. The concept of joint command and control is regarded as most effective when decision superiority exists. The increasing tempo of operations requires quick choices among weapons and effects, in which the emphasis is on parallel planning and execution.[120]

2.1.4 Quadrennial Defense Review Report

Released in 2001, the report states the possibility to identify threats and avoid surprise, but mentions the importance to learn to expect it. Thus the aim is to establish a new strategy that can embrace uncertainty and contend with surprise. According to the report transformation is not seen as a goal for tomorrow, but as an endeavour that must be embraced today.[121] The introduction of the capabilities-based model as basis for defence planning aims at increasing the war-fighting effectiveness of the forces and indicates a process that deals with uncertainty. The new model helps provide capabilities suitable for a wide range of challenges and circumstances within an economic framework necessitating choices. It contrasts developing forces with specific

---

[117] Joint Chiefs of Staff: *Joint Vision 2020,* June 2000, pp. 1-4, Internet, accessed 26. 10. 2004, available at http://www.dtic.mil/jointvision/jvpub2.htm.

[118] Ibid., p. 11.

[119] Ibid., pp. 26-33.

[120] Ibid., pp. 34-37.

[121] Department of Defense: *Quadrennial Defense Review Report,* 2001, pp. IV-VI.

threats and scenarios with a general emphasis on flexibility, adaptiveness, and robustness.[122] One stated defence policy goal in the report is to dissuade future military competition with the dissuasive effect coming from the combination of technological, experimental and operational activities. Another key objective in force transformation is understood as strengthening forward deterrent postures that rests on improved capabilities of forward forces. The resultant deterrent effect in peacetime comes from capabilities that impose strategic and operational effects on the enemy.[123] Force transformation is understood as effects-based as the document regards a small amount of transformed forces a factor that can produce disproportionate strategic effects for further transformation. Also the requirement of forces to be networked is mentioned that help maximise combined effects.[124]

2.2 Army and Air Force

These milestones documents reflect a gradual shift from a traditional, threat-based, firepower-centric, attrition and annihilation-oriented employment of force, to a more sophisticated approach. As a result, members of the services wanted to fill the concept with practical knowledge. Although Joint Vision 2010 emphasises the importance of balanced and sustainable capabilities, and Joint Vision 2020 clearly states that wars should not be expected to be won easily and without bloodshed, Army representatives feared that effects-based operations can cause an imbalance in the traditional role of the services and showed clear scepticism.[125]

2.2.1 U.S. Army Concerns

For a prominent representative of the Army, Gen. Reimer, effects-based operations are nothing more than a technological silver bullet with which proven and balanced battlefield capabilities can disappear. The technological potential of precision strike weapons is a dangerous fallacy that negates the human dimension of warfare.[126] Only fully balanced capabilities can become a solid basis for strategy and result in an overwhelming advantage on the enemy. The right balance of dominant manoeuvre and precision engagement must be retained since the power that smashed the Iraqi forces came from the successful combination of precision engagement and dominant manoeuvre. Although increased lethality and mobility are impressive, only balance provides for choices. Manoeuvre and fire are still the primary elements of combat power. Precision engagement, although a significant contributor to shape the battle space, does not accomplish all tasks. The synergism that comes from the simultaneous application of dominant manoeuvre and precision engagement is still critical. Any dependence on a one-dimensional strategy such as effects-based operations negates the possibility to achieve decisive effects that come from positional advantage and psychological impact. Purely technical solutions cannot

---

[122] Davis, Paul K.: *Analytic Architecture for Capabilities-Based Planning, Mission-System Analysis, and Transformation*, RAND MR-1513, 2002, pp. xi, 1.

[123] Department of Defense, pp. 12, 20, 26.

[124] Ibid., pp. 29, 34.

[125] Joint Chiefs of Staff (1996), p. 27; Joint Chiefs of Staff (2000), pp. 9, 20.

[126] Reimer, Dennis J.: *Dominant Maneuver and Precision Engagement,* Joint Forces Quarterly, Winter 1996-97, p. 13.

eliminate the irrationality of war and relying on technology alone does not provide for appropriate strategy, doctrine or operational concepts.[127] Likewise, other representatives of the Army did not support effects-based operations. According to Col. Cheek, the concept is based on precision weapons and the long-lasting desire of the air service to become independent and commanded by an airman.[128] The information-intensive nature of effects-based operations can overload commanders and planners, and result in an over-centralised command. The concept also performs badly when the enemy reacts, deceives or otherwise manipulates information. The Clausewitzian understanding of compelling the enemy to do our will can also not be realised with effects-based operations. The term is synonymous with control, which means that the enemy has space for making his own decisions. Thus effects-based operations are impersonal, fleeting and persuasive from the enemy's point of view. Consequently, effects-based operations stand for an ill-defined concept as close combat is still the final arbiter of war.[129]

2.2.2 U.S. Air Force Enthusiasm

A supportive, technology driven approach to effects-based operations is given by Lt. Col. Bingham, who sees the concept as modern version of the German *Blitzkrieg*. The key to joint effects-based operations is for him, a theatre team using airborne command, control, intelligence, surveillance and reconnaissance systems that manage the decentralised executions of air sorties against enemy land forces.[130] Since the concept is basically asymmetric, military operations will not depend primarily on physical attrition dominated by the close battle. The use of friendly land manoeuvre only exploits the physical and psychological effects of air attacks on the enemy. Battle management capabilities based on advanced technology make it possible to paralyze the enemy by attacking his mechanized assets. Thus effects-based joint operations reduce or eliminate close combat in three ways:

- First, they halt enemy army units before getting close enough to friendly land forces to employ their weapons effectively.
- Second, they allow friendly land forces to avoid close combat in less than ideal conditions.
- Third, the applied advanced technology provides real-time information to effectively manoeuvre friendly land forces.[131]

Joint effects-based operations take advantage of the central role motorisation plays in modern land warfare. The concept exploits dependence on movement and machines by acknowledging that all armies "depend on vehicles to move units to the battlefield as well as on the battlefield".[132] Advanced airborne technologies are able to see moving or emitting machines in

---

[127] Ibid., pp. 14-16.

[128] Cheek, Gary H. (Col.): *Effects-Based Operations: The End of Dominant Maneuver?,* U.S. Army War College, Carlisle Barracks, 09 April 2002, pp. 8-10.

[129] Ibid., pp. 10-16.

[130] Bingham uses the terms *effects-based joint operations* and *joint effects-based operations* interchangeably. See Bingham, Price T. (Lt. Col., Ret.): *Transforming Warfare with Effects-Based Joint Operations,* Aerospace Power Journal, Spring 2001, pp. 58-66.

[131] Ibid., pp. 58-59.

[132] Quotation in Bingham, Price T.*: Seeking Synergy, Joint Effects-Based Operations,* Joint Forces Quarterly, Spring 2002, p. 53.

real time regardless of darkness or bad weather. Information on location and strength of enemy army units become more reliable and precise. Precision engagement can paralyse the enemy's land forces and reduce his ability to engage friendly army units in close combat. Targeting vehicular movement causes confusion in the form of shock and awe since surviving enemy soldiers will regard movement and massing vehicles as visible, vulnerable and extremely dangerous. Thus sudden and lethal air attacks together with friendly manoeuvres result in a vicious circle with a synergetic effect. Any attempt to escape would cause visible vehicular movement that again increases the vulnerability to air attacks. Effects-based operations can best be described as *vehicle plinking* that is followed by friendly manoeuvres bypassing or defeating paralysed enemy units.[133] The dynamic integration of precision air attacks and surface manoeuvre results in the complementary effects of an intractable dilemma. Whereas moving units invites precision air and missile attacks, not moving means being overwhelmed by friendly air and land forces. The rigorous exploitation of movement and human factors such as fear, fatigue and uncertainty result in quick victory on land. The enemy is reduced to infantry that does not enjoy the advantage of motorisation. Precision weapons not only make military operations more effective and efficient, but increase the perception of danger that friendly actions produce.[134] Consequently, effects-based operations are aimed at achieving system-wide effects without the destruction of significant parts of the enemy system. Advanced technologies enable the accurate location, automatic tracking, reliable characterisation and precision-targeting of individual enemy vehicles and make effects-based operations possible.[135]

---

[133] Bingham (2001), pp. 59-62.

[134] Bingham, (2002), pp. 53-56.

[135] Bingham, Price T. (Lt. Col. Ret.): *Air Power Targeting Theory: A Key Element in Transformation,* Military Review, Maj-June 2002, Internet, accessed 16. 09. 2003, available at www-cgsc.army.mil/milrev/english/MayJune02/bingham.asp.

3 Towards a General Theory

Despite the diversity of approaches the concept of effects-based operations could eventually penetrate to the highest echelons of political and military leadership. As General Ralston, Commander U.S. European Command and Supreme Allied Commander Europe in 2000-2003, expressed during a conference: "we must think in terms of achieving the desired effects. We must transition from attrition-based force on force warfare to effects-based operations".[136] The increasing influence of effects-based operations can also be seen on the expansion of the concept's meaning. In this chapter we conduct a comparative analysis of the seven approaches in order to construct a general theory of effects-based operations based on common elements and characteristics. The chapter will also deliver definitions, and a theoretical framework that helps us approach war in terms of causality. The seven approaches to effects-based operations made it clear that there are various levels of interpretation, which point towards an increasing generalisation of effects-based operations.

3.1 Increasing Generalisations

Originally, effects-based operations stood for a service-centric force employment concept and grew out of the necessity of how to compensate for the scarcity of available resources. During the preparation of the 1991 Gulf war the Americans possessed only a limited number of F-117s. However, intelligence sources discovered that instead of two key command centres there were actually four in Iraq, and potentially a fifth in Kuwait. Based on the capabilities offered by stealth technology and precision weaponry, they redesigned the Master Attack Plan and put only one weapon on every facility. This change resulted in higher efficiency and a greatly amplified coverage in terms of impacts over the enemy. With the revision it became possible to attack 150 separate and discrete targets in the opening first 24 hours of the war, far more than during the 1942-43 bomber offensive over Central-Europe.[137]

3.1.1 Joint Employment of Force

Based on the results of the 1991 Iraq War, the idea of achieving effects on the enemy slowly expanded, and was seen as a reason to move away from the traditional concept of massing forces. In terms of effects, massing ground forces in the traditional manner is no longer important, since they represent a lucrative target for attacks. Effects-based operations make it possible to replace the deployment of force, with the projection of force. As Gen. Deptula

---

[136] Quotation in Ralston, Joseph W.: *Keeping NATO's Military Edge Intact in the 21st Century,* Luncheon Address, given at the NATO/GMFUS Conference, Brussels, 3 October 2002, Internet, accessed 15. 12. 2004, available at http://www.nato.int/docu/speech/2002/s021003d.htm.

[137] *Air Force Operations Concept Aims at Success, Not Destruction, "Effects-based operations" a new but ancient military concept,* U.S. Department of State, International Information Programs, Issues in Focus, an interview with Maj. Gen. Deptula, 21 March 2003, Internet, accessed 06. 10. 2004, available at www.globalsecurity.org/wmd/library/news/iraq/2003/iraq-030321-usia14.htm; According to Mann the advent of advanced technology shifted the principle of mass from the tactical to the operational level, see Mann, Edward (Lt. Col): *One Target, One Bomb, Is the Principle of Mass Dead?* Airpower Journal, Internet, accessed 10. 03. 2005, available at www.airpower.maxwell.af.mil/airchronciles/apj.mann.html.

emphasises, effects-based operations redefine the concept of mass, relies to a greater degree on force projection than on force deployment, and aims to control adversary systems rather than destroy them. All this requires changes in the current approach to force management. It is claimed that effects-based operations deny the traditional approach of the service components to do their own thing and demand new organisations and doctrine. Jointness stands for the use of the most effective force in any given situation, in which effects-based operations act as a functional vehicle that includes not only the air component, but also the entire theatre campaign. For Gen. Deptula jointness is the right force, at the right place, at the right time. It is not using every force, every place, all the time.[138]

3.1.2 Integration of All Elements of National Power

For many, effects-based operations not only provide for a perspective and framework in planning, executing and assessing military operations, but have the power to integrate all elements of national power. This further generalisation suggests that all services operate as part of a bigger, joint interagency effort within a multinational ad-hoc coalition or an alliance.[139] This generalisation regards effects-based operations as a springboard for better integrating the diplomatic, informational, military and economic elements of national and international power. According to this level, desired effects determine engagement methods in which the military force is only one element in the full spectrum of options. The integration of all elements of national power means that the traditional border between military and non-military activities evaporates and an entirely new horizon for better achieving security policy goals opens up.[140]

3.1.3 Systems Acquisition and Procurement

The performance of stealth technology and precision weaponry drove many to conclude that effects-based operations are also helpful in making decisions on resource allocations. Thus we should digress from individual platform costs, and consider other dimensions such as *cost per target engaged* or *cost per desired effect achieved*. This reorientation means that the evaluation of combat systems could be based on terms such as functionality of effects brought to accomplishing national security needs.[141] This broadest generalisation indicates that effects-based operations are also suitable to define the nature and type of forces to be sustained in order to deal with emerging challenges. It appears that the more general the concept becomes, the more it indicates significant consequences for the composition of the armed forces.[142]

---

[138] Deptula (2003b), p. 40; Lambert, Andrew (Air Com.): *The Future of Air Power,* RUSI Journal, 2003, pp. 46-47.

[139] Deptula (2001).

[140] Deptula (1995), p. 5.

[141] Wolfe, Frank: *Air Force Officials To Emphasize Effects-Based Operations in QDR,* Defense Daily, 18 January 2001, Internet, accessed 31. 03. 2003, available at www.dean.usma.edu/socs/ECON/ens/articles/QDR_USAF_18Jan01.htm.

[142] Deptula (1995), p. 12.

3.2 Elements and Characteristics

A comparative analysis of the seven approaches helps us find those common elements and characteristics, which are needed to construct a general theory of effects-based operations. The attributes of the concept can be grouped around three common, but interrelated elements such as *effects focus*, *advanced technology*, and *systems thinking*. Unfortunately, the comparative analysis made it also clear that the characteristics upon which the common elements are built, such as *causality/deduction* for effects focus, *intangibles/control* for advanced technology, and *categorisation/analysis* for systems thinking, are loose ideas that bear dangerous simplifications regarding the nature of war. The focus on direct causality emphasises almost exclusively the strategic level, and similar to the mainstream literature dealing with the Revolution in Military Affairs, no particular attention is devoted to the tactical level. It appears that effects-based operations are fed by the unconditional believe that advanced technologies make it possible to look at the whole and neglect the particular.[143] Despite sporadic references to Clausewitz and friction in war, most approaches give us the impression that both technological prowess combined with an analytical, top-down methodology emphasising clear causality, can turn war into a logically solvable phenomenon. Another problem concerns the term effect as the approaches made it clear that effects-based operations centre first and foremost on achieving effects on the enemy. Common wisdom indicates that the term can have multiple meanings, which does not promote precision and clarity in military language.[144] As one critical observer ironically remarked, if the proponents of the concept "were aware of the many different meanings and usages of the term effect it is doubtful that they would have made it the first choice among the words they wanted to use."[145] Effects-based operations also serve as a vehicle to go back in history as many approaches attempt to reinterpret wars of earlier ages through an effects-based filter. Generalisation of this kind however can distort the meaning of effects-based operations, which will be detailed later in a separate chapter.

3.2.1 Categorising Effects

The diversity of the effects taxonomies in terms of categorisation is bewildering. However, they allow for a twofold ordering, which indicate *general* and *particular* attributes. Effects can be recognised either immediately or after a certain, although finite time has elapsed. In the case of simple physical effects, time can be instantaneous or short. Higher order effects need longer time to mature. It follows from the categorisation that achieving physical effects is rather easy to do and recognise. Achieving and recognising psychological effects is far more difficult. A general subdivision can be defined by intention, order and timing. Intention means that an effect can be intended/desired or unintended/undesired. In terms of order, effects can be direct/first order or indirect/higher order. Timing indicates effects to be permanent or temporary. The particular subdivision rests on level, type and flow. Level refers to tactical, operational and strategic

---

[143] Jobbagy, Zoltan (Maj.): *Effects-Based Operations and the Age of Complexity: A Critical Reflection*, Militaire Spectator, May 2006, pp. 235-242.

[144] Gove, Philip B. (ed. i. ch.): *Webster's Third New International Dictionary of the English Language, Unabridged,* Merriam-Webster Inc., 1981, p. 724.

[145] Quotation in Van Riper, Paul K.: *Precision and Clarity in Military Language*, received via e-mail from author on 05. 09. 2006; Van Riper, Paul K.: *Planning for and Applying Military Force: An Examination of Terms,* Strategic Studies Institute, March 2006, pp. 5-6, 13-15.

effects. Flow reflects the distributive character of effects and describes the way they flow up or down within the enemy system's hierarchy. The difficulty of handling psychological effects is also reflected in the gap between *effect* understood in normal English usage and *effect* as conceptualised in the taxonomies. An effect normally follows an antecedent directly, which means that any reference to indirect or higher order effects becomes questionable at best and nonsensical at worst. The more we move towards intangibles in the form of higher order effects, the more we leave effects-based operations behind, and arrive at something that can better be described as *consequence-based*, *outcome-based* or *event-based* operations. The more we move towards abstract psychological effects aimed at influencing the enemy's behaviour, the more meaningless the term effects-based operations becomes. In the same way Clausewitz also pointed out that "consequences of some kind [would] always follow."[146] As Clausewitz indicated, regardless what we do we achieve effects anyway. This however, can mean that not only the term effects-based operations may be vacuous, but also the concept behind it. In the end we can run the risk to refer to something that is scarcely more than military truism or commonplace.

3.2.2 Theoretical Framework Explained

Many ideas are often passed on down without proper consideration or reflection. Unfortunately, it appears that the same holds true for effects-based operations.[147] In order to elaborate more on the obstacles and opportunities of the concept, we suggest a theoretical framework that helps systematically challenge wide spread and obsolete thoughts regarding the nature of causality in war, and the problems it creates. Clausewitz emphasised that the nature of war is complex, and with the proposed theoretical framework of our own we try to establish a basis to analyse it in terms of causality. Although the problem of causality lends itself to further metaphysical and epistemological considerations, our intention is only to analyse certain properties in broad terms. Discussing effects-based operations on the basis of cause-and-effect relationships draws us onto a long and complex intellectual path of study and continual analysis. The framework is thus an attempt to produce a durable explanation of war's nature in terms of causality and the way cause and effect relate to each other in space and time. It is generic in a true Clausewitzian sense, namely that first and foremost "instead of a complete theory it offers only material for one." Probably the biggest benefit of such an approach is that it helps us understand war in causal terms and, as Clausewitz emphasised to "investigate the essence of the phenomena of war and to indicate the links between these phenomena and the nature of their component parts."[148] The theoretical framework can be seen as a tool that helps develop knowledge throughout the thesis in order to distinguish error from truth. It is also useful to analyse and critique assumptions regarding effects-based operations. A further benefit comes from the fact that this way we can examine the nature of causality in stages working both from narrower to wider settings and vice versa. Thus we establish a context for examining causal relations, which is sufficient in detail and realism to discern relationships between factors.[149] Seeing causality in

---

[146] Quotation in Clausewitz, p. 212.

[147] Moseley, Alexander: *A Philosophy of War,* Internet, accessed 25. 01. 2007, available at www.lewrockwell.com/orig3/moseley1.html.

[148] Quotations in Clausewitz, p. 69.

[149] Rubel, Robert C.: *The Epistemology of War Gaming,* Naval War College Review, Volume 59, Number 2, Spring 2006, pp. 108, 120-122.

war on a continuum as offered by the framework "if nothing else, will help clarify military thinking" in a way that false assumption regarding causal relationships can come to light.[150] Based on Clausewitz we propose a conceptual embodiment reflecting the fact that causality can be both inherently imaginative, and formed through experience. In other words, the properties of cause-and-effect relationships in war are the consequences of our imaginative capacities and the experience of the physical environment in which we act. The framework also offers room for conceptual categorisations in a way that different factors can be linked around common properties. Consequently, it can explain how we unconsciously connect factors, which are ostensibly different.[151]

3.2.3 Theoretical Framework Depicted

War consists of so many factors that most efforts fail to include all applicable forces with the complexity of their interactions.

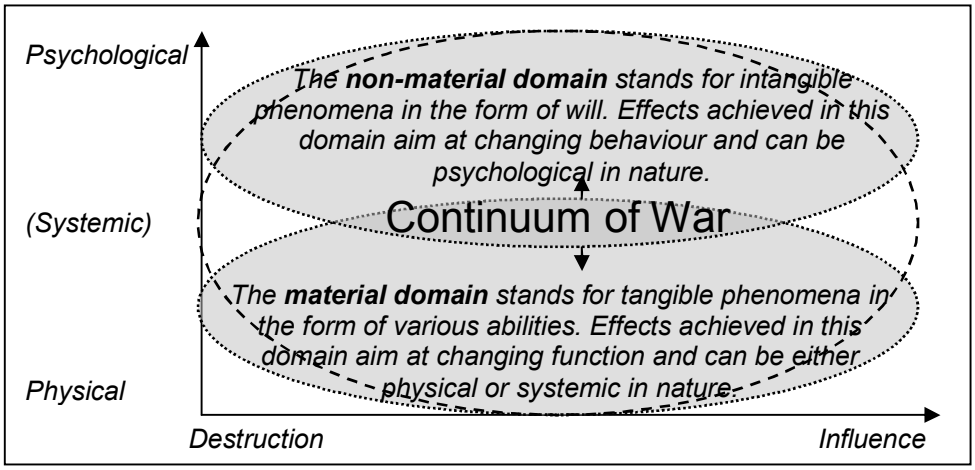

Figure 1: Continuum of war in terms of domains

In accordance with Clausewitz, we understand war as an activity in which both the enemy's physical and psychic forces have to be destroyed. Whereas the destruction of the former can be seen as the means of war, the latter is its objective. Clausewitz advocated that efforts had to be aimed at the enemy's power of resistance, which was "the total means at his disposal and the strength of his will". This indicates that a war can end only if the enemy's will is broken through a "gradual exhaustion of his physical and moral resistance."[152] In a similar fashion the taxonomies of the seven approaches refer to two different, but interrelated domains of war: the *material* and the *non-material* in which effects can generally be achieved. According to Clausewitz the two domains display war as an "extreme trial of moral and physical strength and stamina" in which the actions of the belligerents aim at the "gradual exhaustion of the [enemy's] physical and moral

---

[150] Quotation in Lopez, Antonio M./Comello, Jerome J./Cleckner, William H.: *Machines, the Military, and Strategic Thought,* Military Review, September-October 2004, p. 77.

[151] Johnson, Eric: *WAR in the Media: Metaphors, Ideology, and the Formation of Language Policy,* Bilingual Research Journal, Volume 29, Number 3, Fall 2005, pp. 625-626.

[152] Clausewitz, pp. 102-106 (quotations p. 106).

resistance."[153] The theoretical framework as depicted in Figure 1 indicates that unlike the seven approaches to effects-based operations that put mostly an unilateral emphasis on the moral element, Clausewitz regarded moral and physical elements as both inseparable and interacting. The only difference he saw between the two is that the moral element is the "most fluid element of all".[154]

3.2.4 Theoretical Framework Discussed

We depicted war in a two-dimensional setting as a continuum, which is defined by ends/means relationships. The framework indicates war as a phenomenon, which works in an everything-affects-everything mode thus making various levels of interrelatedness possible. This allows room for both loose and tight structures, which exist side-by-side in war. Whereas ends are depicted on the vertical axis characterised by the combination of physical and psychological effects, the means are located along the horizontal axis and range from destruction to influence. The framework indicates that effects occur on a spectrum characterised both by tangible and intangible attributes. Clausewitz also indicated the existence of a material and non-material domain, by emphasising that war is "a trial of moral and physical forces through the medium of the latter" in which "psychological forces exert a decisive influence on the elements involved".[155] Based on the taxonomies and Clausewitz's advice we propose the following in terms of effects:

- The material domain represents categories such as physical strengths and stamina. It describes the space the military tries to influence through combat and manoeuvre. Consequently, the material domain deals with tangible items the enemy usually needs to wage war. It includes assets such as physical platforms and communications networks. This domain is the traditional basis for measuring combat power, which has to be rendered inoperable. The material domain can also be described as *reality proper*. Attempts to achieve effects in this domain must aim at physical ability and as a consequence serve the purpose of *changing functions*.
- The non-material domain on the other hand, is characterised by psychological factors such as moral strength and stamina. It represents the mind and attributes that generally influence the will in the form of perception, awareness, understanding, belief, and values. Effects in this domain stand for influencing intangibles the enemy needs to wage war. Consequently, effects in this domain serve to *change behaviour*.

When compared to the material domain, the non-material domain is at first appearance non-existent. However, by holding things together it permeates all human endeavours. It appears to be the medium in which act and will merge, and points towards the ability and movement to act. Despite the difference regarding the two domains we assume a strong correlation between them as physical and psychological factors form an organic whole.[156] Whereas Clausewitz regarded

---

[153] Ibid., pp. 80-86, (quotations p. 86).

[154] Quotation in ibid., p. 111.

[155] Quotations in ibid., p. 145.

[156] Alberts, David S./Gartska, John J./Hayes, Richard E./Signori, David A.: *Understanding Information Age Warfare,* CCRP Publication Series, August 2001, pp. 12-14; Huss, John (Maj.): *Exploiting the Psychological Effects of Air Power, A Guide for the Operational Commander,* Aerospace Power Journal, Winter 1999, p. 23; McNicoll, Iain: *Effects-Based Operations: Air Command and Control and the Nature of the Emerging Battlespace,* RUSI Journal, June 2003, p. 39.

the physical the "wooden hilt," the psychological was for him "the real weapon, the finely honed blade."[157]

3.3 Delivering Definitions

According to the theoretical framework, effects can point either to the tangible aspects of war aimed at changing function or to intangibles such as changing behaviour. Whereas the former refers to the tactical level of war, the latter refers to the strategic level.

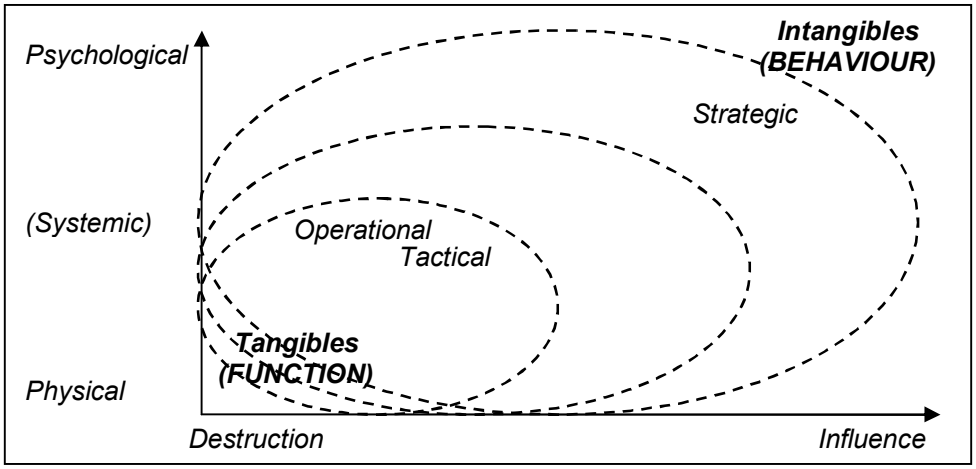

Figure 2: Effects as interrelated phenomena

In order to fill the continuum the term *systemic effect* as indicated by some approaches appears to be appropriate. Systemic effects, similar to the operational level of war link the two end-poles in various ways expressing the fact that effects can flow freely between the two. The taxonomies also made it clear that effects have a distributive character as they flow from lower-order to higher-order status and vice versa. In other words, effects are interrelated entities, which form an organic whole. Therefore we suggest depicting the relationship of effects in the form of three distorted rings as shown in Figure 2, each referring to one level of war. Based on the seven approaches we also state that achieving an effect requires the involvement of a dynamic and a static component. Whereas the dynamic component is our action, the static component is the object upon which we act. This approach provides for a broad framework in which we see causality as an expectation for certain events to result after the other events preceding them. Thus we suggest understanding the problem of causality in a true Humean manner. According to Hume causation stands for "such a connexion, as to give us assurance from the existence or action of one object, that [is] follow'd or preceded by any other existence or action; nor can the other two relations be ever made us of in reasoning, except so far as they either affect or are affected by it".[158] Approaching cause-and-effect relationships this way also helps us understand

[157] Quotations in Clausewitz, p. 217.

[158] Hume, David: *A Treatise of Human Nature,* Oxford University Press, 1978, pp. 73-74.

the mechanism of achieving an effect in which (E) can be understood as a function (f) of an action (a) on an object (o), and depicted in the form of a simple equation such as

$$E = f(a,o)$$

In order to explain the equation we suggest first analysing the term *object* in more detail since in our understanding *object* appears to fit better to actions than other frequently used terms such as *target* or *agent*:

- Target is very much destruction oriented, and has an exclusively military connotation. It is mainly associated with the application of kinetic means and stands for destructive assets such as platforms, weapons, and explosives.
- Agent is fleeting and too neutral in nature. It is either associated with the material dimension of war and means an instrument to achieve a result, or with the human dimension and stands for acting or exerting power.
- Object describes something that is materialised in its nature and can be elements of a system or the system itself. Thus it does not make a difference, whether an object is a living or a non-living entity. It stands for perception by the senses and indicates something we can see, smell, hear, taste and/or touch.

Simply put, an object is nothing more than a cause for attention. It can not only refer to systems, sub-systems and elements, but also to their relationship. Consequently, an object can also be a process that is in the material domain, but is not materialised and possesses no physical characteristics such as size, shape and weight. In this sense we regard a radio transmission that can be jammed also an object.

3.3.1 Two Definitions

A thorough systematisation also requires clear definitions in order to turn the loose similarities found in the seven approaches, and expressed in common elements, into a neat theory. Thus we define effects-based operations as ***a force employment concept aimed at achieving effects on the enemy, which is enabled by advanced technology and a systemic approach***. In a similar fashion for an effect we propose the following definition: ***a physical, systemic or psychological resultant condition, aimed at inducing functional and behavioural changes of the enemy***. For a better understanding of war in terms of cause-and-effect relationships we suggested a theoretical framework in which war is depicted as a continuum defined by ends/means relationships. The common elements and characteristics we discerned indicate that the main focus of effects-based operations is somewhere around the psychological/influential end-pole as depicted in Figure 3. Consequently, effects-based operations can be located in the upper right area in the continuum of war. The figure also allows us for addressing the tree sorts of effects we outlined earlier in more detail as follows:

- *Physical effect* – it is regarded mainly as the outcome of a certain action or actions on an object that alters the object's physical condition through modification or destruction.
- *Systemic effect* – it can either be the product of some physical effects or the outcome of certain actions on a system, which alters the system's performance through modification or destruction.

- *Psychological effect* – it may be the outcome of the interplay of certain physical and systemic effects, or some actions aimed at the enemy's cognition in order to alter his perception and induce a behavioural change.

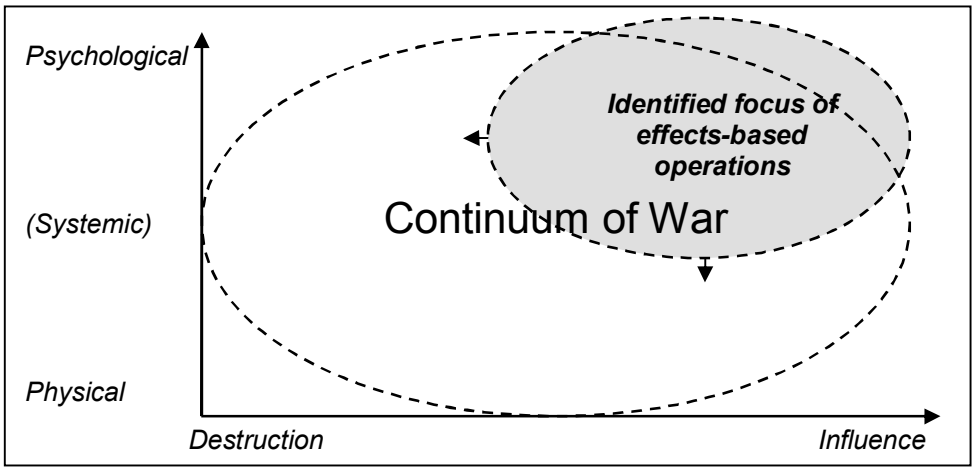

Figure 3: Effects-based operations in the continuum of war

Although physical effects are normally associated with the tactical level of war, to a lesser degree they may also have systemic and psychological consequences. Systemic effects are mostly associated with the operational level of war as they have both physical and psychological attributes. A given amount of physical destruction can cause systemic effects or such effects can be the result of operations collapsing certain functions that help maintain the enemy's war-making or war-sustainment capabilities. However, psychological effects can also result in systemic effects as it was the case with Iraqi power plant directors who feared bombardments and shut down their facilities as soon as an F-16 took off.[159]

3.3.2 Multiplicity in Causality

The proposed theoretical framework suggests effects to be inherently complex and interrelated. Although both causes and effects can be identified in advance, objects and actions can theoretically be fully known, the mechanism needed to achieve desired effects always contains an amount of uncertainty.[160] This is also addressed in most approaches, and can be described as the vulnerable Achilles-heel of effects-based operations. As we move towards higher order psychological effects, it becomes increasingly difficult to identify causal linkages. Whereas causes can be seen as limited proposition-like facts, effects refer to actual changes and processes that can go on indefinitely. War is a phenomenon in which we can never do only one thing: the enormous array of interactions generates endlessly complex alternatives that make it very difficult if not impossible, to isolate individual causal relationships. The higher the complexity of the situation encountered, the lower our ability to detect useful causal relationships, and at a

[159] Denny, Anthony, D.: *U.S. Air Force Uses New Tools to Minimize Civilian Casualties,* Internet, accessed 20. 08. 2003, available at www.stratwise.com/countries_us_civ_casualties.htm.

[160] Emmet, Dorothy: *The Effectiveness of Causes,* Macmillan, 1984, pp. 64-75.

certain threshold we might find characteristics that are almost mutually exclusive.[161] This sheds light also on the problem that we often do not understand the subtle difference between *exactness* for which causes stand for and *correctness* representing effects. Whereas causes can mostly be verified through direct experimentation, effects can only be postulated from theories not amenable to direct proof. In other words, desired effects are nothing more than extrapolations of a known past onto an unknown future. Humans tend to see the relationship between past and future in causal terms and "think that the past has 'more reality' than the future."[162] Human behaviour allows both for stochastic and functional associations, which mean that the consequences even of repeated actions are never constant, but cover a range of possibilities. Although on occasion we might have sufficient knowledge of the possible consequences, or even adequate knowledge for estimating certain statistical probabilities of some possible consequences, it will never be possible to predict with certainty, the consequences in any particular case. Hence we will never be able to define completely homogenous categories or categories with sufficient homogeneity that allow for accurate predictions based on causality. The problem with the mechanism further indicates that we always have to expect a deviation between the effects desired and the effects achieved. Past experience might allow for discerning general rules, but helps little in anticipating the direction and extent of deviations. A mechanism that was successful under a given condition to achieve an effect will not obviously be successful under all conditions. Regardless the information we have at our disposal we can attend to only some aspects of a situation, but never to all aspects. War indicates complex interactions in which even the actions of one belligerent have ramifications. Consequences are never restricted to the area they were originally aimed at, but might occur in areas that are interrelated, though ignored at the time the action was taken. Predicting the consequences of complex interactions is also problematic since the prediction itself can become an important new element that influences the initial course of actions. As soon as desired effects become explicit and actions proceed, the assumption that *other-things-being-equal* is no longer valid. The introduction of new *other things* in the form of desired effects, points towards inconsistency, which often account for unforeseen, unexpected and unanticipated consequences.[163]

3.3.3 Further Problems

Effects-based operations suffer from semantic problems, which in the end mystify ideas rather than help clarify them. The concept reflects the tendency to explain a complex human phenomenon such as war in the framework of a causal nexus, composed of a network of causal processes and interactions. Humans tend to confuse the nature of change with the causation of

---

[161] Storr, Jim: *A Critique of Effects-Based Thinking*, RUSI Journal, December 2005, pp. 34-35; Duczynski, Guy A: *To what extent can knowledge management systems build and reinforce consensus around initiatives for change?: A self-reflective analysis of professional practice*, Ph. D. thesis, Edith Cowan University, November 2001, pp. 131-136.

[162] Sakulich, Timothy J. (Lt. Col.): *Precision Engagement on the Strategic Level of War: Guiding Promise of Wishful Thinking*, Occasional Paper Number 25, Air University, December 2005, pp. 15-26; Horvich, Paul: *Asymmteries of Time, Problems in the Philosophy of Science,* MIT Press Classic Series, 1987, pp. 129-145 (quotation p. 143).

[163] Merton, Robert K.: *The Unanticipated Consequences of Purposive Social Action,* American Sociological Review, December 1936, pp. 898-904; Gove pp. 1729-1730.

change. Generalisations relating causes to effects can only be true in one or at best in some, of the underlying properties. As soon as the properties blur in spatial and temporal terms no disposition can deliver useful generalisations, and we have to rethink in terms of co-variation or correlations rather than imposing causality.[164] Both co-variation and correlation stand for phenomena that follow one another in a regular fashion, but do not imply causal relationships per se. Nevertheless, people tend to interpret cases of co-variation and correlation as manifestations of causality. We are too ready to assume causality and often confuse causation with co-variation and correlation.[165]

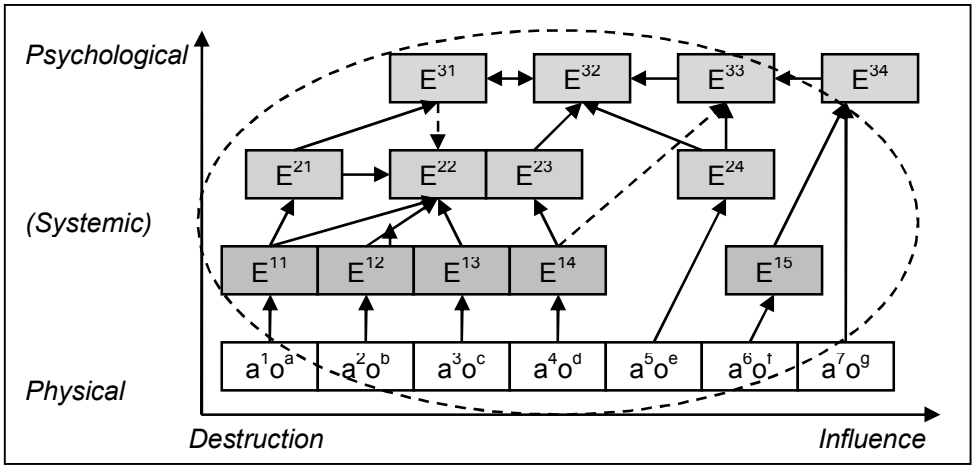

Figure 4: Mechanism – the propagation of effects

The problem of finding useful mechanisms points towards at least four limitations we have to consider in order to harness the power of effects-based operations: the need to understand the enemy as fully as possible; the need to understand causal relationships between actions and higher order effects; the ability to assess the consequences of our actions in terms of enemy will and behaviour; and to synchronise our actions with the different requirements demanded by the various levels of war. Regardless what mechanism we select, war's proverbial friction works against detecting clear causal relationships. Friction indicates variation in terms of causal relationships. This variation is due to the fact that friction does not allow discerning something that can be seen as absolute.[166] Despite the optimism we discerned in the seven approaches regarding the ability to link causes and effects directly and comprehensively, we must bear in mind that "absolute objectivity, clinicalism, and precision in mapping causation are unattainable

---

[164] Abdoullaev, Azamat Sh.: *The Ultimate of Reality: Reversible Causality,* Internet, accessed 16. 11. 2006 available at www.bu.edu/wcp/Papers/Meta/MetaAbdo.htm; McCullagh, Behan C.: *Natural Necessity, Objective Chances and Causal Powers*, Internet, accessed 16. 11. 2006, available at www.bu.edu/wcp/Papers/Meta/MetaMcCu.htm.

[165] Cheng, Patricia W.: *From Covariation to Causation: A Causal Power Theory,* Psychological Review, Volume 104, Number 2, 1997, pp. 367-369, 398.

[166] McCrabb, Maris "Buster" Dr.: *Limitations to and Effects-Based Approach to Planning, Executing or Assessing Military Operations*, received via e-mail from author on 12. 11. 2006, pp. 1-5.

ideas" both in general as outlined by Hume, and in our particular case, which is war.[167] Nevertheless, Figure 4 depicts some aspects of such a mechanism. Most mechanisms (a^1o^a to a^6o^f) are physical operations that aim at achieving effects in the physical domains (E^{11} to E^{14}) by hoping that they can indirectly induce higher order subsequent effects both in the material (E^{21} to E^{24}) and non-material domains (E^{31} to E^{33}). Some mechanisms can also achieve systemic effects directly (a^5o^e to E^{24}). A more complicated mechanism in psychological operations (a^7o^g) tries to initiate effects in the non-material domain directly (E^{34}). Effects can both cascade (from E^{11} to E^{21} and E^{22}) or become cumulative (E^{11}, E^{12} and E^{13} to E^{22}) as they move through the enemy system. Effects can also jump through the various levels of war (E^{14} to E^{33} and E^{15} to E^{34}) displaying the fact that according to fortunate circumstances even simple physical effects can have disproportionate consequences. In effects-based operations higher order effects can influence lower order effects (E^{31} to E^{22}). Effects on the same level may also be interrelated (E^{21} to E^{22}) as they can also mutually enforce each other (E^{31} and E^{32}). Mapping cause-and-effect relationships are even theoretically very complex, and can hinder most attempts to predict which cause results in what effect. Attempts that focus on detecting causality can easily result in *paralysis by analysis*, especially in terms of desired higher order effects in which causal relationships are usually not directly identifiable. Another problem concerns the relationship between decision-making and time. In general, we can say that the shorter the time available the more likely it is that we think in terms of a relevant analogy rather than look for alternatives based on sophisticated analysis.[168]

---

[167] Quotation in Beaumont, Roger: *War, Chaos, and History,* Praeger Publishers, 1994, p. 27; Hume, pp. 82-84.

[168] Smith (2006), p. 129.

4 Historical Overview

Many approaches to effects-based operations state that the concept is far from being new since astute commanders, statesmen and the like have always practiced this sort of operations.[169] In this chapter we examine the truth of this assumption. The problem with simplified statements of this kind is that they indicate a generalisation, which de-emphasises specific social, political, cultural and economic factors that have always been important in the evolution of warfare. All the phenomena that support war including organisations and conventions, depend on a combination of certain historical circumstances. As the social wave-front analysis indicates, any manifestation of war is the result of societal transformation and mirrors social conditions.[170]

4.1 Four Classics of Strategy

The danger of superficial generalisations is that they turn any given phenomenon into its own caricature, and logically meaningless. Clausewitz warned that if an idea becomes diffuse it starts losing proper meaning and its value declines accordingly. Certain principles of war can survive ages or be rediscovered occasionally. However, the main reason for their endurance is often not due to their value or utility, but their simplicity and exceptional convenience. Strategic theory is always a framework, and as such independent from the size and scale of the conflict, the medium that hosts it, the means by which it is fought, and likewise the amount of violence it involves. In general it is the combination of efficiency and effectiveness with the aim of finding a balance between these two attributes. It follows a mostly deductive logic whereby a conclusion about particulars, flows from a course of actions rooted in a general or universal premises.[171] The term effect refers to resultant conditions that follow an antecedent, which explains why strategy can be understood as effects-based. Consequently, references to effects-based operations as an ancient phenomenon, point towards strategy in general terms rather than the existence of an early version of the concept. Displaying effects-based operations as an ancient concept explains everything and nothing at the same time. Therefore it is useful to take a close look at the vocabularies of significant past theorists of war in order to examine to what extent their works can be regarded as sources of effects-based operations. The following comparative analysis does not intend to deliver a broad historical, philosophical, cultural or even linguistic overview. The intention is to allow the respective authors to speak for themselves as they represent different periods within the first two waves. The aim is to detect reference points towards the three common elements of effects-based operations such as effects focus, advanced technology, and systems thinking. The following theorists of war will be subject to this analysis: the Chinese classic Sun Tzu representing ancient China; the Italian Niccolo Machiavelli

---

[169] Crane, Conrad: *Effects-Based Operations: A Blast From the Past,* Commentary, Defense Week, 14 May 2001, p. 16; McNicoll, p. 38.

[170] Toffler/Toffler, pp. 1-18; Creveld (1991), pp. 112-122.

[171] Clausewitz, pp. 554, 624; Brodie, Bernard: *Strategy as a Science,* World Politics, Volume 1, Number 4, 1949, pp. 471-475; Creveld (1991), pp. 157, 218; Robbins, Stephen P.: *Organization Theory: Structure, Design, and Applications,* Prentice-Hall International Editions, 1987, pp. 25-49; Hooker, R. D. Jr.: *Beyond Vom Kriege: The Character and Conduct of Modern War,* Parameters, Summer 2005, p. 4.

representing the Italian city-state of the late Medieval Age; the Swiss Antoine Henri de Jomini and the Prussian Carl von Clausewitz, both representing the emerging modern nation state.

4.1.1 Sun Tzu

The ancient Chinese strategist Sun Tzu lived around 500 B.C. and belongs to the earliest known military theorists. His book *The Art of War* became known in Europe shortly before the French Revolution. Its summary translation was first published in Paris in 1772 and soon became widely circulated.[172] He is the first known theorist who attempted to formulate the planning and conduct of military operations on a rational basis that enabled a successful prosecution of war. In the chapter on strategic assessment, Sun Tzu emphasised that intelligence was required to change plans effectively. He also wrote about effective discipline by stating that subordinates did not dare to disobey orders which were effective. Sun Tzu also mentioned effective armament together with carefully chosen and trained troops. As an effective method he suggested appearing weak whilst being strong, and appearing cowardly whilst being brave in reality. In order to confuse the enemy he mentioned the importance of giving the impression of being incompetent and ineffective whilst the opposite was true in reality. Sun Tzu concluded that formlessness was the most effective in military operations and unexpected movements the most efficient.[173] In the chapter on planning a siege, Sun Tzu wrote that the inability to deploy machines effectively could cause great trouble. For him there was also a difference between military and civilian life, especially in customs regarding military procedure and command in effect. He found that adaptation to the situation was important as sometimes even a large group could not effectively attack a small group. Conquest depended for him on co-ordination and not mass.[174] In the chapter on formation, Sun Tzu wrote that sometimes there was no chance to see any effective way to attack, and defence was the better option by not letting the opponent find our forces.[175] In the chapter on force he concluded that good warriors sought effectiveness in battle from the force of momentum and not from that of individuals.[176] In the subsequent chapter on emptiness and fullness he proposed attacking gaps and, among others, he mentioned the inability to affect rescues. The ability to affect rescues meant for him fullness, which he regarded as worth defending.[177] In the chapter on terrain he named six factors that resulted in defeat and one of them was the ineffectiveness of law and order.[178] In the chapter on nine grounds, Sun Tzu wrote of an effective rulership, which rests on firm knowledge regarding the enemy's plans, the lay of his land and the use of local guides.[179] In the chapter on fire attack he suggested not to go against the momentum of fire, because it was not effective as the enemy would surely fight to the death.[180]

---

[172] Sun Tse*: L'art de la guerre, Traduit du chinois par le pére Amiot,* Éditions Didot Faîné, Paris, 1772.

[173] Tzu, Sun: *The Art of War,* Shambhala Dragon Editions, Shambhala Publications Inc., 1988, pp. 41-56.

[174] Ibid., pp. 66-83.

[175] Ibid., pp. 84-92.

[176] Ibid., pp. 93-99.

[177] Ibid., p. 103.

[178] Ibid., pp. 143-147.

[179] Ibid., pp. 148-163.

[180] Ibid., pp. 164-167.

4.1.2 Niccolo Machiavelli

The Italian thinker Machiavelli published his book *Art of War* in 1521. As a child of the renaissance and living in the city state of Florence, he viewed military problems in relation to politics. He devoted great attention to the procedures he regarded as important for the acquisition, maintenance and application of a well-equipped and highly trained military force. He suggested adapting the military practices of the ancient Romans, but also pointed out the difficulties of its accomplishment. Machiavelli outlined fundamental questions such as creating an army, individual armaments and organisation of military units, formations in battle and during marches, command and control, encampments, intelligence operations, and fortifications and sieges. In book one he suggested that the military should be made up of people who were not fully forced or fully committed to this profession. An army composed only of committed people would carry wicked effects as such people were for him without restraint and religion, like gamblers or blasphemers. Machiavelli concluded the middle way to be the best when people join the military due to their respect for the prince, which prohibits bad effects arising.[181] In book three whilst detailing the order of battle of the ancient Romans he mentioned that lightly armed men were posted in front of the army between the cavalry and infantry. When they were repulsed they could withdraw along flanks or through "intervals ordered to such an effect" and re-establish themselves among the unarmed people.[182] Regarding the signs on the flags of the army Machiavelli proposed that the captain-general should bear the sign of the prince. The signs of subordinate commanders were for him not that important as long as they had the effect of recognising each other.[183] In book five he detailed the marching order of the Roman army. According to Machiavelli the Romans sent ahead some groups of cavalrymen followed by the right horn, then by the wagons belonging to it, followed by one legion and its wagons, another legion with its wagons, the left horn with the wagons behind and then the rest of the cavalry. After this listing he concluded that this "in effect was the mode in which [the Roman army] marched ordinarily."[184] For marching through a hostile country he suggested the army to be in a square since this formation was good both for marching and fighting, and "to this effect" he proposed ordering a brigade in the same way.[185] In a situation when an army was between two mountains occupied by the enemy and there were only two roads, he suggested that the commander should make a ditch at the rear and give the impression of forcing the army through the only road that remained open. This act could mislead the enemy who concentrates his forces on the remaining open part prepared to fight. However, if the commander "[threw] a bridge of timber ordered to such an effect over the ditch" and crossed that obstacle, he could escape the enemy.[186] In book six Machiavelli detailed the importance of information on enemy activities and plans requiring spies, ambassadors and experts of war. However, he emphasised that the enemies were also active in this field, which became manifest "when one [took] prisoners from them to this effect."[187] In book seven Machiavelli gives 27 general rules on war, but the rules do

---

[181] Machiavelli, Niccolo: *Art of War,* The University of Chicago Press, 2003, p. 23.

[182] Quotation in ibid., p. 64.

[183] Ibid., p. 81.

[184] Quotation in ibid., p. 101.

[185] Quotation in ibid., p. 102.

[186] Ibid., p. 114 (quotation p. 114).

[187] Ibid., pp. 133-139 (quotation p. 133).

not contain terms such as *effect*, *effective* or *efficient*, or refer to the importance of achieving effects on the enemy.[188]

4.1.3 Antoine Henry de Jomini

The strategist and historian Jomini was an officer in the Napoleonic wars. His book *The Art of War* was first published in 1838, and can be seen as a synthesis of his practical military services and a thorough historical study. In chapter one he illustrated the importance and effect of wars of intervention, which were for him wars of opportunity. Regarding national wars he thought that the efficient defence of a country should rest on organised militia to limit the barbarities of war.[189] In chapter two Jomini praised the great advantage of the lance and concluded that lancers were inferior to hussars as skirmishers, but more effectual in charges. He also mentioned the Congreve rockets "the effect and directions of which … the Austrians [can] now regulate".[190] He acknowledged the contribution of councils of war, advising how the commander could contribute to more weight and effect of military operations. Enthusiasm and military spirit were for him factors that produced the same effects: passion that was temporary and the more permanent great love of the country.[191] In chapter three he concluded that converging routes were better for defence since two retreating divisions "[could] effect a junction more quickly" and may defeat the pursuers separately.[192] He also wrote that prejudice towards entrenched camps as bases of operations does not allow generals to trace the effects back to their real causes. By explaining the term *objective point* he used a fictitious scenario in which the French army's task was to "relieve the forts … if the enemy succeeded in effecting a passage of the river and in besieging them".[193] He also emphasised the significance of a position in the rear within which divisions could collect and oppose the enemy if he becomes successful in effecting a passage. Regarding the French declaration of war in April 1792, Jomini could not understand why the French did not conquer Belgium in which there was "no effectual resistance."[194] The behaviour of the allies in the campaign of 1793 was for him an example of the effect that a "faulty direction of operations" has.[195] His maxim number ten concerning lines of communication stated that two such lines must be arranged in a way that passing armies are able to effect their junction without being separately exposed to the enemy. According to maxim number fifteen, on crossing a large river in the presence of a numerous enemy the first consideration should be "to ascertain where the passage can be most certainly effected".[196] By examining the advantage of the central lines in the case of very large masses and concentric operations, he used expressions such as *effecting a junction*, the *effect of suffering reverses*, and *effecting a union of two armies*. He also emphasised the effects of roads on a retreat and the advancement of armies so as to effect a

---

[188] Ibid., pp. 157-159.

[189] Jomini, Baron Antoine Henri de: *The Art of War,* Greenhill Books, London, Stackpole Books, Pennsylvania, 1992, pp. 22, 34.

[190] Quotation in ibid., p. 48.

[191] Ibid., pp. 47-62 (quotation p. 48).

[192] Ibid., pp. 76-80 (quotation p. 76).

[193] Ibid., pp. 82-90 (quotation p. 89).

[194] Ibid., pp. 100-105 (quotation p. 105).

[195] Ibid., pp. 106-118 (quotation p. 107).

[196] Ibid., pp. 120-138 (quotation p. 120).

junction. In his epitome of strategy he wrote that the "system of rapid and continuous marches multiplies the effect of an army", which can be magnified if those marches are directed "upon the decisive strategic points of the zone of operations".[197] In chapter four on grand tactics and battles Jomini suggested the selection of tactical position to be done in such a way that it should give "the artillery all its effect in the defense."[198] In his analysis regarding offensive and defensive positions in a battle, he emphasised the importance of the moral effect that comes from movement towards enemy lines. Such an advance can only be stopped by well-placed batteries that produce the "greatest effect" on the approaching assailant. The moral effect of the subsequent counterattack was for him "enough to stagger the boldest troops."[199] Regarding battles he wrote that force must be employed to "obtain the most effective action" since this offers the biggest chance for success.[200] In detailing the different orders of battle, he wrote about *effecting the decisive manoeuvre and detours* around the enemy's flank. A perfect order of battle was for him one that "united the double advantages of the fire of the arms and of the moral effect produced by an onset."[201] The retreat of the first line had for Jomini a moral effect on the second, resulting in loss of command over the troops involved. Regarding the fire of musketry, he admitted that it was much more effective in defence than in offence. In his analysis of various campaigns he used expressions such as *effecting a detour* and the *effect of discouraging the enemy*.[202] In chapter six on logistics he again used terms such as *effecting a junction* and the *effective capture of enemy soldiers*.[203] In chapter seven on the formation of troops he wrote about the *greatest and destructive effects of the artillery* and the *effect that comes from shock when attacking with pikes*. Among others he mentioned *moral effects in battle*, which came from being in a column and having arms at the shoulder without firing a shot. Further references included the *effect of the enemy's fire*, the *effect of arms improvements*, the *momentary effect of a cavalry charge*, *the effect of artillery and musketry fire*, the *moral effect of reverse fire upon troops* and the *efficiency of rocket batteries in frightening horses*.[204]

4.1.4 Carl von Clausewitz

No other theorist has shaped military thinking in the Western world more than Clausewitz. Although his sudden death deprived him of the opportunity to finish his work properly, even in its incomplete form, *On War* is one of the most influential and voluminous book ever written on the matter. The sheer volume of the book prohibits a similar display with the other authors, but it also differs in some respects. Clausewitz not only used words such as *effect*, *effective* and *efficient* significantly more often than the previous authors, but he also delivered a detailed analysis regarding cause-and-effect relationships and the way effects interact. In book one on the nature of war, he used terms such as *disproportionate effect*, *combined effect*, *moderating effect*, *effect*

---

197 Ibid., pp. 175-177 (quotation p. 176).

198 Ibid., pp. 180-184 (quotation p. 181).

199 Ibid., pp. 185-186 (quotations p. 185).

200 Ibid., pp. 187-192 (quotation p. 187).

201 Ibid., pp. 195-205 (quotation p. 201).

202 Ibid., pp. 210-216.

203 Ibid., p. 273.

204 Ibid., pp. 289-318.

of fear, and *restrictive effect*. He also wrote about the *effective way of using force* and the *effective forms of fighting*.[205] In book two on the theory of war he referred to *psychological effects*, *particular effect*, *moral effects*, *effects of danger* and the *effect of the engagement*. However, what makes his work interesting is contained in chapter five, in which he delivered a critical analysis, which he understood as an attempt to trace effects back to their causes. For him facts and the underlying motives are seldom fully known in wars, and the deduction of effects from their causes is difficult. Therefore causes remain mostly unknown due intentional concealment or improper recording. Since effects do not always come from known causes, there are always gaps in terms of causality, and ignoring this can cause serious problems. Clausewitz was convinced that effects in war cannot be traced back to a single cause, as several concurrent causes are normally at work. It is not sufficient to trace effects back to their causes, but the causes themselves must be assessed correctly. He regarded investigation of the nature of effects important, otherwise the analyst faces the danger of unending arguments that lead to no conclusion. Regarding effects and their causes, it is impossible to establish laws and standards, although reliance on aids in the process of judgement can be helpful. For Clausewitz, investigating the relationship between cause and effect becomes easy only if they are closely linked. Unfortunately, in war everything is interconnected and effects produced influence all subsequent events, as for the final outcome every means available influence the ultimate outcome. When tracing effects back to their causes, every step means that effects become causes themselves. An effect that appears correct at one level can become objectionable on a higher level and imply a new basis for judgement. This hierarchical chain indicates serious problems since he regarded the distance between cause and effect proportionate to the number of other causes to be considered. Consequently, the range of forces involved and circumstances that must be taken into account grows: the higher the effect the greater the causes by which they could be achieved. In order to comprehend the intricate and difficult nature of causal relationships in war, Clausewitz advocated a critical analysis to illuminate the connections and determine essential concatenations. This analysis is even more important since people are biased and tend to blindly follow single line of thoughts. As the analysis goes towards psychological forces and effects, reliable evaluation becomes increasingly cumbersome. Regarding the will, which he defined as the interplay between courage and fear, even critical analysis cannot determine probable outcomes. Although he was aware of the difference and interrelatedness of physical and psychological effects, he emphasised that “the psychological effect is what concerns us”.[206] In book three, he insisted that a strategic theory must consider not only material factors, but also moral qualities since physical and psychological effects form an organic whole. Furthermore, he referred to the *effect of the engagement*, the *effects of genius*, the *ricochet effect of forces*, *desired effects*, *destructive effects*, and the *effect of the advantage*.[207] In books four to seven his vocabulary included a wide array of effects such as the *effectiveness of additional forces*, *effect of surprise*, *effective integration of the individual parts of the army*, *effective sphere of operations*, *effective range of weapons*, *strategic effectiveness*, *effectiveness of resistance*, *effective strategic move*, *effectiveness of diversion* and *immediate*

---

[205] Clausewitz, pp. 83-142.

[206] Ibid., pp. 145-204 (quotation p. 199).

[207] Ibid., pp. 207-262.

effect.[208] In the last book concerning war plans he emphasised that so many factors influence military campaigns that the "almost infinite distance … between a cause and its effect" reveals an endless combination of the elements involved.[209] The maximum that can be achieved is to work in a comprehensive fashion to avoid "narrow formulas for solving problems".[210] Commanders should rely on the capacity of their mind with actions being "a response to the immediate challenge rather than a product of thought."[211] He further wrote about *effective blow against the principle ally*, *intentional effect*, *maximum effect of an attack*, and *effective help*.[212]

4.2 Effects-Based Vocabulary

All of the four selected theorists' vocabulary contain terms such as *effect, effective*, and *efficient* to various degrees. However, attempts to reinterpret their work on effects-based principles means that their theory and methods are used to explain present day phenomena. The result is a naive and one-dimensional misconception that disregards influential and historical circumstances of their respective age.[213] We made it clear earlier that effects-based operations rest on three common elements such as *effects-focus*, *advanced technology* and *systems thinkin*g. These elements served as the vehicle for our examination back in time in order to detect the theorists' relevance for effects-based operations in detail.

4.2.1 Effects Focus

Statements that the origins of effects-based operations lay with Sun Tzu, because he wrote that "killing is not the important thing" appear to be far fetched and biased. His recommendations have validity only in their own historical context. Sun Tzu intended his advice not as replacement for, but as an adjunct to, the actual use of force. Citing him in order to validate present day strategic theory disregards the particular reality and the particular praxis of his age.[214] His significance is due to the fact that Sun Tzu was probably the first who understood the importance of strategy and forming strategic alliances as an alternative to bloody wars. References such as the ability to overthrow a city without throwing a rock only highlights the existence of various alternatives that have always existed to bloodshed.[215] A vocabulary that uses the term effect and its derivatives does not indicate a certain early conceptualisation of effects-based operations. No theorist delivered better, fresher and more detailed analysis on the relationship between cause and effect than Clausewitz. However, he did not do it in an attempt to formulate any early concept of effects-based operations. As a soldier-cum-philosopher, he wanted to warn theorists that reality is too multifaceted for single-minded causal explanations.[216] Despite the diversity and

---

[208] Ibid., pp. 265-693.

[209] Ibid., pp. 697-698 (quotation p. 698).

[210] Ibid., pp. 698-701 (quotation p. 699).

[211] Ibid., pp. 710-722 (quotation p. 720).

[212] Ibid., pp. 725-779.

[213] Bassford, Christopher: *John Keegan and the Grand Tradition of Trashing Clausewitz,* War and History, November 1994, pp. 319-336.

[214] Quotation in Sun Tzu, p. 66; Chisolm, pp. 117-118.

[215] In one interview Gen. Deptula used this example.

[216] See further Brodie's commentary in *On War*, pp. 788-790.

frequency with which he used such words, *On War* fails to give a detailed analysis, categorisation and definition of effects. His statement of disinterest in generals who promise to win victories without any drop of blood may appear to be a blow for the proponents of effects-based operations. His cynical style of writing about the higher skill of avoiding decisive battles and reaching goals by other less violent means does not qualify him as the forerunner of the concept either. For him, war was brutality and blunder, and as he concluded history has scattered attempts to win bloodless wars to the winds.[217] Although both Machiavelli and Jomini can be positioned between Clausewitz and Sun Tzu, Machiavelli's vocabulary is the least effects-based. It is the best example that using the term effect does not indicate the existence of an effects-based vocabulary. In the original Italian, *effetto* the equivalent of the English *effect* is mentioned only ten times, and never in an effects-based way.[218] One probable explanation is that Machiavelli was less interested in how an army fights and more how it is possible to establish and sustain one that fight once it occurs. His argumentation relates the armed forces as much to the political aspects of war as to operational employment. In this respect, he was probably among the first theorists in the Western world who raised an issue roughly similar to the concept of long-term defence planning. The absence of the term effect in his many rules of war reflects a clear lack of thinking in this regard. Jomini's vocabulary was much more interwoven with references to effects, although not to the same extent as that of Clausewitz. He personally preferred chivalrous warfare to organised assassination. Unfortunately, he cannot be seen as one of the forefathers of effects-based operations since for him, this sort of warfare stood for a certain epoch, but not phenomenon.[219] His four maxims regarding the fundamental principles of the art of war do not contain any reference to effects. He thought in terms of massing armies and massing forces, which stand in sharp contrast to the rather balanced and delicate approach of effects-based operations focusing on massing effects.[220] The idea of throwing the masses upon the decisive point forms a recurrent pattern in his work, and clearly negates the chance of an early conceptualisation of effects-based operations. Although he knew that armies could be destroyed without pitched battles, this option was for him, the "succession of inconsiderable affairs."[221] He often referred to the moral effect, but did not attempt to examine the way it could relate to actions and physical phenomena. Thus using the term effect and its derivatives and thinking in an effects-based way do not mean the same.

4.2.2 Advanced Technology

We devote the next scrutiny to the technological aspect of effects-based operations. No theorist put considerable emphasis on elaborating the difference that technology can make in war. Despite the millennia that lie between Sun Tzu and Clausewitz, and the centuries between Machiavelli and Jomini, weapons were operated mostly by muscle and being mounted on a horse was the fastest means of advancement. It does not come as a surprise that speed in military operations was best understood and practiced by confederated horse riding nomads such as the Huns, Avars, Hungarians and Mongols who invaded Europe throughout the ages.

---

[217] Clausewitz, pp. 308-309.

[218] Machiavelli, p. 236.

[219] Jomini, pp. 34-35.

[220] Ibid., p. 70.

[221] Ibid., pp. 85-88, 139, 178 (quotation p. 178).

Due to their mobility they conducted brilliantly executed campaigns and as the Mongols showed, at a speed that could be repeated by European armies only five and a half centuries later on the corps level. Seven full centuries had to pass before all military operations were conducted at a speed that even Subotai Khan would have accepted.[222] Another example for the missing technological aspect can be found in Machiavelli and his relationship with artillery, the first and foremost military technological innovation of that age. Due to their size and weight, cannons were very hard to use in the beginning and were regarded as extremely unreliable, inaccurate and risky. However, they heralded the end of primeval warfare and paved the way for the wars to come. For Machiavelli artillery was useless, and could be overcome by ancient modes and ancient virtue. Jomini himself did not regard technology as a significant aspect of war either. According to him superiority of armament can increase the chances of success, but it does not gain battles in itself. It is just one, albeit great element of success. Although he was aware of the numerous technological improvements that took place during his lifetime and made war more destructive, he saw their effects basically to force troops to prefer shallower formations. Similar to Jomini, Clausewitz did not regard the technological aspect of war, manifested in weapons and equipment, as important. For him, they were not essential to the very concept of fighting as he thought that the act of fighting determines the weapons employed. The range and effectiveness of firearms were only of tactical importance. He saw the relevance of new technologies mostly in their psychological impact on the enemy, but not as enablers of military operations. As he concluded, armies of his age were very similar in weapons, training, and equipment. Consequently, he saw little difference between the best and the worst armies.[223] It appears that the military lessons of past ages were not significantly influenced by changing technological conditions until the second half of the 19th century. Although the disparity between methods and weapons used became clear as early as the Crimean and American Civil Wars, it was only World War I that displayed the immense gap. Weapons of industrial mass production with an ever-increasing destructive potential shattered the value of past military experience only in the 20th century. Regarding the technological aspect of effects-based operations, none of the four authors can be regarded as originator of effects-based operations since they did not regard technology as leverage.

4.2.3 Systems Thinking

Regarding systems thinking, more similarities can be detected with effects-based operations. For Sun Tzu the way of battle was measured by five things such as the *way*, *weather*, *terrain*, *leadership* and *discipline*. Way stood for inducing the same aim in order to share death and life without the fear of danger. Weather meant the four seasons, terrain referred to distance, difficulty, dimension and safety. Leadership was composed of intelligence, trustworthiness, humaneness, courage and sternness. Discipline stood for organisation, chain of command and logistics.[224] Machiavelli did not provide such an explicit categorisation, but the sequence of his books might reveal some sort of systematisation. Book one describes the qualities needed for

---

[222] Perret, p. 64; Gilbert, pp. 50-52.

[223] Machiavelli, pp. 71-76; Gilbert, Felix: *Machiavelli: The Renaissance of the Art of War,* in: Paret, Peter: Paret, Peter (ed.): *Makers of Modern Strategy, From Machiavelli to the Nuclear Age,* Princeton University Press, 1986, p. 23; Jomini, pp. 47, 299; Clausewitz, pp. 145, 167, 199, 335.

[224] Sun Tzu, pp. 42-45.

war and discusses the role of fortune and virtue. Whereas book two details initial armament and unit organization, book three addresses battles, formations and describes the value of artillery at length. In book four he describes the role of the environment and addresses strategies of movement together with the psychological condition of troops. Book five details marching orders, communication, and ambushes. Book six contains encampments and intelligence, but pays special attention also to health, medicine, and supply lines. Book seven discusses fortifications in detail. Jomini's categorisation of the art of war aims basically to manifest five military branches such as *strategy*, *grand tactics*, *logistics*, *engineering*, *tactics*, and *discipline*, and one civilian branch called *diplomacy*. Strategy equalled war made on the map, with the aim to direct masses properly in the theatre of war. Grand tactics was the positioning of troops in order to bring them into the action to fight. Whereas logistics was the art of moving armies comprising means and arrangements, while engineering meant the art of attacking or defending fortifications. Tactics mainly described the actual fighting, including actions such as charges, repulsions and positioning troops. Diplomacy meant statesmanship and its relationship to war efforts. For Clausewitz, a systemic approach might have been the subdivision of war into his famous paradoxical trinity, the *people* with a creative spirit unleashed and free to roam, the *military* standing for subordination as an instrument of policy, and the *government* that makes war subject to reason alone.[225] Thus concerning the aspect of systems thinking, we can say that at least three of the authors wanted to grasp the essence of war in systemic terms. Claims that throughout history effects-base operations have always been applied by talented commanders are, at least, only partly true.

4.2.4 Carriages and Cars

We can state that works of the four theorists have at best an indirect relationship with effects-based operations, but cannot serve as origins of the concept. Referring to past theories and making forced links to support present day strategic thought is appealing. It provides useful tools to validate one's own arguments with reference to the classics, and offers better prospect and stronger arguments for selling ideas in order to gain influence. However, any such reference can jeopardise a well-founded understanding of the message and the theoretical implications of effects-based operations. It prohibits the decoding of unique historical conditions and detaches theory from practical relevance. Instead of seeing both the theoretical forest and the contextual trees it offers only theoretical trees and a contextual forest, which is superficial, misleading and extremely dangerous.[226] A carriage pulled by a horse, and a car driven by a combustion engine reveal obvious similarities, but do not indicate that those who invented the carriage also had the car in mind. If we understand war and effects-based operations in a social context then we assume specific factors and conditions. For Clausewitz it was clear that "every age had its own kind of war, its own limiting conditions, and its own peculiar preconceptions. Each period … would have held to its own theory of war, even if the urge had always and universally existed to work things out on scientific principles. It follows that the events of every age must be judged in

---

[225] Jomini, pp. 2, 66-70, Clausewitz, p. 101.

[226] Meyer, Andrew/Wilson, Andrew R.: *Sunzi Bingfa as History and Theory,* in: Lee, Bradford A./Walling, Karl F. (eds.): *Strategic Logic and Political Rationality: Essays in Honor of Michael I. Handel,* Frank Cass, 2003, pp. 99, 116-117.

the light of its own peculiarities."[227] Following his advice we must conclude that the origins of effects-based operations must lie much closer to our time. In reality, the reason why effects-based operations came into being was the scarcity of available aerial resources during the 1991 war against Iraq. As Gen. Deptula stated during an interview the concept grew out of the practical problem of how to compensate for this shortcoming. The unexpected success of the approach and the power of advanced technology resulted that effects-based operations became "the philosophy … we used in targeting for the rest of the war planning effort and then during the war".[228]

---

[227] Quotation in Clausewitz, p. 717.

[228] Quotation in *Air Force Operations Concept Aims at Success, Not Destruction,* interview with Maj. Gen. Deptula, Internet, accessed 28. 03. 2003, available at http://www.globalsecurity.org/wmd/library/news/iraq/2003/iraq-030321-usia14.htm.

5 Military Coercion

In this chapter we will prove that the vocabulary of most air-power theorists reveals striking similarities with the three common elements of effects-based operations. Aimed at certain vulnerable elements of the enemy the intention was to achieve victory less through the application of brute force in the physical domain, but more through various coercive mechanisms aimed at influencing the psychological domain. The focus on influence and psychological effects came as a result of a powerful technological innovation of the early 20th century, the airplane. We defined effects-based operations as ***a force employment concept aimed at achieving effects on the enemy, which is enabled by advanced technology and a systemic approach***. Similar to the definition, air power theorists have also advocated the application of mechanisms of military coercion to achieve various sorts of effects on the enemy. The assumption has always been that the power of advanced technology in the form of the airplane makes it possible to go directly to the heart of the enemy thus making war less bloody and perhaps morally acceptable. This image of war rested on the assumption that technological development and a systemic top-down strategic approach make possible to attack enemy vulnerabilities directly.[229]

5.1 Air Power Theories

Major wars of the 20th century disproved much of such assumptions. World War II was extremely destructive as the focus was more on the physical domain than on achieving higher order psychological effects. Massed firepower and large-scale destruction were regarded as first and foremost decisive factors, which reflected the "tendency among the industrialized nations to employ force beyond reason."[230] The seven approaches to effects-based operations made it clear that the concept focuses on control instead of destruction. The clear relationship with military coercion theories is obvious as the aim is at the sources, and not manifestations of power. [231] Unfortunately, in the area in which air power theories and military coercion theories overlap, technological developments and practical considerations have often played greater roles than ideas with real-world relevance. Another peculiarity of the overlapping is that not only does the vocabulary used differ from one theorist to the other, but the same term can refer to different things for the same author at different times.[232] Nevertheless, a thorough examination of air power theories advocating various coercive mechanisms to achieve victory in war can explain the preference for control and shed light on the fundamental differences between destruction

---

[229] Cooper, Scott A.: *Air Power and the Coercive Use of Force,* The Washington Quarterly, Autumn 2001, p. 81.

[230] Boyd, John: *Patterns of Conflict,* December 1986, pp. 111-113, Internet, accessed 22. 03. 2005, available at www.d-n-i.net/boyd/pdf/poc.pdf; Wijk, Rob de*: The Art of Military Coercion, Why the West's Military Superiority Scarcely Matters,* Mets & Schilt, 2005, p. 117.

[231] Meilinger, Philip S.: *The Origins of Effects-Based Operations,* Joint Forces Quarterly, Issue 35, pp. 116-122; Quotation in MacIsaac, David: *Voices from the Central Blue: The Air Power Theorists*, in Paret, Peter: *Makers of Modern Strategy, From Machiavelli to the Nuclear Age,* Clarendon Press, 1986, p. 636.

[232] MacIsaac, in Paret (ed.), pp. 624-625, 633.

and influence. This is important as destruction and influence mark the two end poles on the horizontal axis of our theoretical framework. There is a general consensus that there are four different schools of military coercion theories. Each school stands for one mechanism and can be described as *punishment*, *risk*, *decapitation*, and *denial*.[233] It is impossible to detail all the ideas that have contributed to the literature of military coercion, but the introduction of well-known representatives from respective schools can help us understand underlying assumptions. The following comparative analysis aims at identifying the types of effects the respective schools stand for, the technology that made the theories possible, and the extent to which these theories reflect a systemic approach. Throughout the chapters the four schools of thought will be confronted with battlefield realities in order to examine to what extent they have worked in reality.[234]

5.1.1 Obvious Similarities

Limitations in terms of means applied together with the focus on desired psychological effects support the assumption to regard effects-based operations as a coercive concept. According to Gen. Deptula, he would once like to see "a set of integrated physical and cognitive effects models that could help … achieve … national security objectives without the adversary even knowing that he's been influenced."[235] Similar to effects-based operations, military coercion theories are built on the assumption that a limited application of force can be sufficient to make the enemy comply, thus leading to lower overall costs and less bloodshed. Military coercion means to convince, and not to force, the enemy to concede by precluding any alternative physically. It is a form of explicit power that does not rely on direct and exclusive application of force, but emphasises reasoning and the persuasion of the enemy in order to change behaviour. Due to its attractiveness, coercion is often perceived as a quick and cheap solution to complex international problems. Coercion has also a strong economic focus as "commerce and prosperity of civilized nations are so closely interwoven and interdependent that the destruction of the enemy country's economic wealth recoils on the head of the victor."[236] Technological and political aspects of the post-modern age such as complex contingencies including small wars, and operations other than war, and advanced military technology, make military coercion very attractive. Whereas the technological aspects enforce the interest in it, the political aspects enable it. Increasing globalisation and interconnectedness also mean that any attempt to "fight a purely destructive war is neither clean nor heroic; it is just purposeless."[237] Military coercion means influencing the enemy's behaviour by manipulating his cost-and-benefit calculations with

---

[233] Pape, Robert E.: *Coercion and Military Strategy: Why Denial Works and Punishment Doesn't?* Journal of Strategic Studies, Volume 15, Number 4, December 1992, pp. 423-475.

[234] Mueller, Karl: *Strategies of Coercion: Denial, Punishment, and the Future of Air Power,* Security Studies 7, Number 3, Spring 1998, p. 183; Compare Pape, Robert E.: *Coercion and Military Strategy: Why Denial Works and Punishment Doesn't?* Journal of Strategic Studies, Volume 15, Number 4, December 1992 with Pape, Robert E.: *Bombing to Win, Air Power and Coercion in War,* Cornell University Press, 1996.

[235] MORS Workshop, January 29-31 2002.

[236] Simpson, Christopher: *Science of Coercion, Communication Research and Psychological Warfare 1945-1960,* Oxford University Press, 1994; Mueller (1998), p. 184; Pape (1996), p. 2; Quotation in Liddel Hart, Basil H.: *Paris or The Future of War,* E. P. Dutton & Company, 1925, p. 43.

[237] Quotation in Schelling, Thomas C.: *Arms and Influence,* Greenwood Press, 1976, p. 216; Cimbala, Stephen J.: *Coercive Military Strategy,* Texas A&M University Press, 1998, pp. 10-12.

the aim to achieve the same political goals as with brute force, but with the involvement of fewer resources. It is an attempt to achieve victory on the cheap in which the coercers often tend to "overestimate the prospects of coercion and underestimate the costs."[238] As an alternative to unlimited destruction, military coercion emphasises that confrontations can be better settled through the selective application of force aimed at modifying enemy behaviour. Although the emphasis on influence over destruction does not exclude the application of force, combined with alternatively negotiated solutions military coercion tries to avoid the escalation of violence.

5.1.2 Carnage of the Trenches

The genesis of modern military coercion theories dates back to World War I and the carnage encountered in the trenches. After the war many were convinced that further wars of this kind would mean the demise of Western civilization and regarded it as a great waste of resources that exhausts both the victor and the vanquished.[239] Theorists started to search for new approaches and questioned the need to confront large forces in a fashion that extended attrition and annihilation. Instead of applying brute force to make the enemy comply, theorists started to focus on quicker and cheaper mechanisms emphasising coercion rather than destruction. Their efforts aimed at exploiting the difference between coercion and the application of brute force, which is manifest in getting what someone can take by force or make the other to give it voluntarily, in order to avoid risk or damage. Military coercion does not exclude the involvement of force, but it is applied in a limited way in order to induce changes in enemy behaviour. It requires intimidation to make the enemy realise that it is his decision to fight and eventually die, or to surrender and live.[240] The potential offered by coercion was persuasive enough to drive the search for better and more humane applications of force. Undoubtedly, there is a striking difference in terms of mechanism between brute force and military coercion. Whereas the former aims at complete destruction of the enemy's capabilities to resist, the latter seeks to persuade the enemy prior to military defeat. Brute force rests on attrition and annihilation, which demand killing more enemy troops than the own side loses. Brute force comes as the result of unlimited aim and unlimited method in which the focus is on wearing down the enemy to the extent he no longer possess an organised force. Brute force results in physical defeat that comes as a result of direct, unconditional actions eliminating the enemy's ability to do anything other than comply. Military coercion accepts that the enemy might have a certain capacity to command his forces by offering the chance of mitigation and solving security challenges short of major war.[241] As Figure 5 depicts, similar to effects-based operations the primary focus on psychological effects places military coercion in the upper right area of the continuum of war. The psychological focus indicates the assumption that it is less expensive to convince the enemy to surrender than to make his resistance physically impossible. Military coercion stands for a camouflaged war, which

---

[238] Pape (1996), pp. 2, 12-15 (quotation p. 2).

[239] Liddel Hart (1925), p. 4; Liddel Hart, Basil H.: *Strategy,* Frederick A Praeger Publishers, 1967, p. 370; Douhet, Guilio: *The Command of the Air,* USAF Warrior Studies, Office of the Air Force History, 1983, p. 12.

[240] Schelling, Thomas C.: *The Strategy of Conflict,* Harvard University, 1997, p. 2; Crowder, Gary L. (Col.): *Effects Based Operations Briefing*, United States Department of Defense, News Transcript, Internet, accessed 19. 03. 2003, available at www.defenselink.mil/news/Mar2003/t03202003_t0319effects.html.

[241] Liddel Hart (1925), pp. 74, 75; Liddel Hart, Basil S.: *The Revolution in Warfare,* Faber and Faber Ltd., 1946, p. 74; Pape, p. 13; Johnson/Mueller/Taft, pp. 8-9.

is based mainly on political manoeuvres in the diplomatic field that can transition into military operations if necessary.[242] We can say that whereas brute force is aimed at the enemy's physical capabilities, military coercion rests on the exploitation of potential violence to influence the enemy's behaviour. In case the enemy does not comply, force is applied only as limited military actions to persuade him.[243]

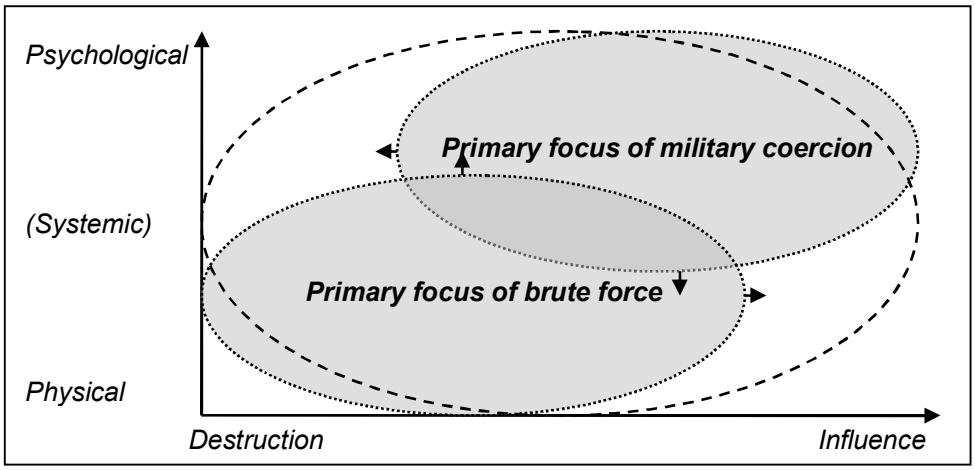

Figure 5 Different focuses of brute force and coercion

Military coercion regards fighting power as a flexible tool that helps achieve psychological effects. Brute force sees fighting power as a blunt instrument to achieve an end-state regardless of enemy behaviour. Similar to the assumptions of effects-based operations military coercion stands for a more gradual, adequate and sophisticated response involving a broader range of means.[244]

5.2 Types of Coercion

Coercion in general can be defined as "the use of threatened force, including the limited use of actual force to back up the threat, to induce an adversary to behave differently than it otherwise would." [245] In normal English usage terms such as *to coerce* and *coercion* have the following meanings:

- Coercion is synonymous with force. Whereas meaning one (a) says that it is an act, which includes the use of both physical and moral force to compel to act or assent, (b) states that it

---

[242] Johnson, D. E./Mueller, K. P./Taft, W. H.: *Conventional Coercion Across the Spectrum of Operations, The Utility of U.S. Military Forces in the Emerging Security Environment,* RAND MR-1494, 2002, pp. 7-10; Liddel Hart (1946), p. 87.

[243] Schelling (1976), p. 214; Cimbala, pp. 162-164.

[244] George, Alexander L.: *Coercive Diplomacy: Definition and Characteristics,* in: George, Alexander L./Simmons, William E. (eds.): *The Limits of Coercive Diplomacy,* Westview Press, 1994, p. 10; Rhodes, Edward: *Power and MADness, The Logic of Nuclear Deterrence,* Columbia University Press, 1989, p. 82; Liddel Hart (1967), p. 364; Liddel Hart (1925), p. 44.

[245] Quotation in Byman, D. L./Waxman M. C./Larson, E. V.: *Air Power as a Coercive Instrument,* RAND MR-106-AF, 1999, p. 10.

is a power or force that coerces. According to meaning two, coercion is the application of sanctions in order to compel dissenters to conform. Meaning three emphasises it as a physical force tending to constrict or compress.

- Meaning one of to coerce indicates restraint, control or domination; meaning two defines it as to compel an act or choice by force, threat or other pressure. Definition three is the most general and stands for effecting, bringing about, establishing or enforcing by force, threat or other pressure.[246]

Both verb and noun stand for an outside influence that includes the possible application of force or a forceful act. Based on the definitions above, coercion can be seen both as an act and a form of power. It is a kind of control subset to some types of exercises that reveal a power relationship with two universally recognised and intrinsic elements, such as the players and their actions. As an example the term *coercive internationalism* refers to this power relationship by taking incompatibilities between states for granted, but aims at abstaining governments with colliding interests from escalation and war.[247]

5.2.1 Threat and Choice

Coercion in its purest form must not include the actual use of physical force since the power relationship includes all means of influencing behaviour through the threat of harm. Coercion is a two-sided activity in which the enemy is forced to perform or is restrained from performing a certain act. In both cases actions and their consequences are detached from his desire as he is not able to choose freely, but only to comply or risk a penalty. Thus the enemy can choose only from a restricted set of alternatives since his will is subjected to that of the coercer. In this sense, coercion is a particular way of bringing the enemy to perform an action under threat.[248] Threat coerces more than the reality of actions; therefore the coercer's capabilities might matter less than what the enemy thinks the coercer can do with his capabilities. Coercion takes the perception of threat for granted and requires a communication of incentives about the automatic consequences. Threat indicates the involvement of overt actions and not intentions with the assumption that "one asserts that he will do, in contingency, what he would manifestly prefer not to do if the contingency occurred, the contingency being governed by the second party's behaviour."[249] Although threat plays an important role in coercion it is only a substantial, but not sufficient element. Sufficient coercion depends on the nature of the act, the character of the harm involved and the circumstances framing that threat. Threat can never occur in a vacuum since it is not intrinsically or inevitably coercive:

---

[246] Gove, p. 439.

[247] Rosenbaum, Alan S.: *Coercion and Autonomy, Philosophical Foundations, Issues, and Practices,* Greenwood Press, 1986, pp. 3-11; Goldmann, Kjell: *The Logic of Internationalism, Coercion and Accommodation,* Routledge, London New York, 1994, pp. 44-45.

[248] Hoekema, David A.: *Rights and Wrongs: The Justification of Coercion and Punishment,* Ph. D. Thesis, Princeton University, February 1981, Authorised Facsimile by University of Microfilms International, Ann Arbor, Michigan, USA, 1985, pp. 4-9, 10-17.

[249] Mueller (1998), p. 223; Jervis, Robert: *Perceiving and Coping with Threat,* in: Jervis, R./Lebow, R. N./Stein, J. G. (eds.): *Psychology and Deterrence,* The John Hopkins University Press, 1985, p. 13; Schelling (1997), pp. 35-41, 123 (quotation p. 123).

- It can become insufficient either because it is simply not severe enough to achieve its purpose, or not sufficiently severe to leave the opponent with only one reasonable choice.
- Whereas the first is insufficiency in relation to the opponent and circumstance, the second is insufficiency in relation to the act.[250]

Threat indicates that the enemy acts in the only reasonable, but not necessarily the only possible way. Threat must also be sufficiently serious to compel the enemy into acquiescence. He must be threatened with a penalty that is severe enough to justify him in submitting. Coercion is forcing the enemy to choose one option over another by making one more attractive. It is a message about what the enemy should do with the difference in possible consequences. Threat alters the attractiveness of options available with the prospect of both a negative and a positive sanction. Coercing the enemy requires coercive power in order to achieve a desired outcome by influencing enemy behaviour. Coercive power rests on a contingent strategy, credibility and commitment. Unfortunately, coercion cannot always be successful since the enemy is either rational and thinks that suffering the imposed unpleasantness is still more attractive than yielding, or he is irrational and insensitive towards the sanctions imposed. Consequently, coercion is context-dependent and only successful if we are able to alter key components in the enemy's decision calculus to compel concessions.[251]

5.2.2 Deterrence and Compellence

Although context dependency indicates coercion to be simple in theory, but complex in practice, a rough subdivision into two broad categories such as *deterrence* and *compellence* is helpful.[252] Both categories rest on mechanisms that manipulate the enemy's decision-making calculus either by the threat of force or its limited application. They are intimately linked in reality since deterrence refers to something the opponent is already doing, which includes some aspects of a compellent threat. Whereas in compellence the enemy is promised some reward if he yields, in deterrence he faces a certain threat of pain if he does not.[253] A further differentiation can be based on whether the enemy must merely refrain from acting, must stop doing an ongoing activity, or start a desired one. Deterrence and compellence reflect the difference between a threat, intended to make the enemy do something and a threat intended to keep him from starting something. The distinction is based on timing and initiative.[254] Whereas deterrence is rather passive, compellence is more active. The former is a static action and means setting the stage and waiting, the latter is dynamic and stands for initiating an action or gaining momentum

---

[250] Hoekema, pp. 21-27; On threat see Nozick, Robert: *Coercion,* in: Morgenbesser, S./Suppes, P./White, M.: *Philosophy, Science and Method, Essays in Honor of Ernest Nagel,* St. Martin's Press, 1969, pp. 441-472.

[251] Hoekema, pp. 30, 38; Rhodes, pp. 82, 83-84, 86; Pape (1996), p. 38.

[252] Byman/Waxman/Larson, p. 9; Wijk (2005), pp. 85-121; Johnson/Mueller/Taft, p. 10; Byman/Waxman/Larson, pp. 69-78; Schaub, Gary, JR.: *Compellence: Resuscitating the Concept,* in Freedman, Lawrence (ed.): *Strategic Coercion, Concepts and Cases,* Oxford University Press, 1998, pp. 40-46.

[253] Byman, Daniel/Waxmann, Matthew: *The Dynamics of Coercion, American Foreign Policy and the Limits of Military Might,* Cambridge University Press, 2002, pp. 6-9; Pape (1996), p. 4; Schelling (1976), p. 77; Rhodes, p. 83; Wijk (2005), p. 12.

[254] Treverton, Gregory F.: *Framing Compellent Strategies,* RAND MR-1240-OSD, 2000, p. 4; Schelling (1976), p. 69; Freedman, Lawrence: *Strategic Coercion,* in: Freedman (ed.), pp. 18-20.

to make the opponent act. Regarding timing, deterrence is rather indefinite, but compellence more definite, since too little time makes it impossible and too much unnecessary. Assurances accompanying compellent actions are also difficult to demonstrate in advance, but in deterrence the need for assurances emerges as an integral part. Deterrence is something like a defence, and compellence is more like an offence, but as soon as the confrontation starts the difference may vanish as coercion includes both. Whereas in deterrence there is a connection between the proscribed action and threatened response, in compellence the connection is less defined or does not exist as compellent mechanisms usually depend on threat and demand. Deterrence is more future-oriented, since a threatening act intended to dissuade the opponent from undertaking an action is not yet initiated. Compellence seems to be more cumbersome in this regard as it does not offer a distinction between the defensive and offensive aspects of coercive threats. Compellence simply does not leave space for other aspects, such as rational persuasion and accommodation.[255] In terms of future aspects deterrence may include promises of rewards for complying with the coercer's demands. Complying with one's demands might be more attractive and has the same effect as making defiance less attractive. Deterrence is convincing the enemy not to take an action by making the expected benefit appear worse than the consequences of not acting. It involves preventing the opponent from an action that has not yet materialised. The point is that in deterrence nothing happens until the enemy acts contrary to our demand. Deterrence seeks to discourage the opponent by altering his behaviour and influencing his calculus for decision-making. Deterrence is a preventive approach to avoid certain outcomes rather than an approach aimed at bending the enemy to our will. Compellence is more active and better recognisable under duress. The difference between the two is similar to that of inducing inaction or making the enemy perform. Thus compellence involves attempts to reverse an action that has already occurred in order to overturn the status quo.[256] Compellence means causing an action favourable to our demands as successful threats do not have to be carried out, but violence may be used in order to influence the enemy's perception. Compellence appears to be more risky since the initiative is ceded to the opponent, who can decide upon the duration and cost of resistance. In general we can say that compellence tends to be more difficult than deterrence. It is harder to force the opponent to reverse an action, than to not carry it out. Threat in compellence can take the form of administering the punishment until the enemy acts, and not *if* he acts. Success in compellence depends on the connection between threat and demand, which can range from physical to psychological.[257]

5.2.3 Schools and Mechanisms

Although compellence is more difficult than deterrence, many deterrence situations can turn out to be cases of compellence. Compellence also involves persuading the enemy to stop an ongoing action or to start a new course of action by changing his calculations regarding costs and benefits. In terms of the threatened sanctions, compellence seems to be more complex than deterrence, although both share the vocabulary of threat and imply punishment in some form.

---

[255] Schelling (1976), pp. 70-76, 78-80, 86-90; George, p. 7.

[256] Johnson/Mueller/Taft, pp. 10-11; Byman/Waxman, pp. 6; Schelling (1997) p. 197; Pape (1996), p. 4; Krause, Keith: *Rationality and Deterrence in Practice,* in: Snyder, Craig A. (ed.): *Contemporary Security and Strategy,* Macmillan Press, 1999, p. 121; Schelling (1976), p. 175; Byman/Waxman/Larson, p. 10.

[257] Schelling (1997), pp. 90, 196.

The spectrum of coercion is characterised by compellence and deterrence, which indicates a huge bandwidth for possible coercive mechanisms. Similar to effects-based operations successful military coercion means understanding the basic logic of actions and the sensitivities of the enemy. It goes together with a careful selection of proper mechanisms in order to affect those sensitivities and the way they change over time.[258] Based on writings during the Cold War, the literature of military coercion is dominated by deterrence. Although during that period deterrence was seen as the main business and compellence the exception, such preoccupations have distorted the concept and often do not apply to the circumstances political and military decision-makers face today.[259] Nevertheless, the two categories and the four schools of thought each describing one mechanism, will serve as a solid background for examining the similarities between effects-based operations and military coercion.

[258] Krause, p. 121; Pape (1996), p. 12; Treverton, pp. 5-6; Pape (1992), p. 429.

[259] Schelling (1976), pp. 100, 176; Wijk, Rob de: *The Limits of Military Power,* The Washington Quarterly, Winter 2002, pp. 82-85; Wijk (2005), pp. 15-16; Jakobsen, Peter Viggo: *The Strategy of Coercive Diplomacy: Refining Existing Theory to Post Cold-War Realities,* in: Freedman, pp. 62-85.

6 Menace from the Air

This chapter introduces the first two schools of military coercion, which are punishment and risk. The first school, punishment can be seen as a reaction to the brutality of trench warfare during World War I, which was perceived by many as a march in barbary. As a reaction, strategists everywhere wanted to answer the question of how wars could be waged more cleanly, more decisively, more intelligently, and as humanly and civilised as possible. These theorists believed in technological developments and saw the airplane as a revolutionary instrument that offered alternative means to the futility and immobility of trench warfare. Punishment means that air power is applied against population centres in order to achieve a quick inside-out collapse of the enemy. Punishing civilians for supporting war efforts was regarded as a better mechanism for achieving victory than being dragged into static military engagements based on attrition and annihilation.[260] The major theorists we introduce in this chapter are Douhet, Mitchell, members of the Army Air Corps Tactical School (AACTS), and de Seversky, all representing punishment. In respect to risk we introduce Brodie and Schelling.

6.1 Punishment – Enthusiasm for New Technology

Strategists of the inter-war period searched for ultimate means with maximum leverage in order to shorten time and save resources. Their efforts were based in the context of total war between modern industrialised nation-states and focused on reducing war sustainment capabilities by affecting enemy population. Their theories reflected a mechanical image of war in which victory would go to the nation with the greatest industrial resource. Strategists assumed that the entire population together with all national resources would be required to wage war successfully as wars would be total in character and scope. They wanted to avoid excessive bloodshed on the battlefield and instinctively sensed that the coming era stood for a new age, and saw war in technological terms. Industrial mass production, increasing mechanisation, and the combustion engine made them assume that future wars were bound to be a matter of material and machinery.[261] They uncritically believed in the supremacy of the recently introduced aerial weapon and stated that applied independently, it could destroy any target on its own. Their ideas were filled with enthusiasm for the recently introduced new service. These theorists were confident that air power could produce the speedy moral collapse of the enemy, which comes as a result of quick and decisive effects. The trenches demonstrated the limitations of surface forces; therefore the airplane was seen as a sort of advanced technology and regarded as a superior alternative. These early theorists are all punishment-oriented since they did not make a

---

[260] Malik, J. Mohan: *The Evolution of Strategic Thought,* in: Snyder, Craig A. (ed.): *Contemporary Security and Strategy,* Macmillan Press, 1999, p. 25; Faber, Peter (Lt. Col.): *The Development of US Strategic Bombing Doctrine in the Interwar Years: Moral and Legal?,* Journal of Legal Studies, 1996/1997, Internet, accessed 14. 07. 2005, available at www.au.af.mil/au/awc/awcgate/interwar/faberdbd.htm.

[261] Liddel Hart (1925), pp. 3, 53; Douhet, p. 5; Bassford, Christopher: *Clausewitz in English: The Reception of Clausewitz in Britain and America, 1815-1945,* Oxford University Press, 1994, p. 151; Slessor John C.: *Air Power and Armies,* Oxford University Press, 1936, p. 61; Earle, Edward M.: *The Influence of Air Power,* in Emme, Eugen M. (ed.): *The Impact of Air Power, National Security and World Politics,* D. Van Nostrand Company, 1959, pp. 106-108.

difference between military and non-military objectives. Consequently, governments everywhere assumed the worst, and starting with the 1930's the heavy shadow of bombers hung over the cities throughout Europe.[262] In general, the mechanism of punishment targets the enemy nation's will to resist, by making life so unpleasant and difficult that people would rise up and prefer to comply with terms of surrender, rather than endure the imposed misery. Later punishment was not limited to hitting the population and referred to the killing of military personnel in large numbers in order to exploit casualty sensitivity of the enemy. Either way, the aim is to increase costs of suffering that a society has to pay should it continue with the resistance. In military terms, punishment means relentless bombing of civilian centres or damaging the enemy's economy in order to cause shortages in key supplies and services.[263]

6.1.1 Command of the Air - Douhet

The Italian military strategist, Giulio Douhet, was the first among air-power theorists who advocated the superior quality of the airplane. He regarded the air as a battlefield, and lobbied for air power's independent application since Douhet regarded any auxiliary role conceptually illogical. Victory in war depended on the technical means applied, from which the air power and the application of poison gases were the most significant. War was a conflict between two opposing wills in which air power was able to fly far behind fortified lines to make its effect felt deep in the enemy country. The application of airplanes meant that all enemy citizens could be exposed to offensives from the air since air power does not differentiate between soldiers and civilians. Thus there was no effective defence against determined efforts aimed at bombing cities.[264] Douhet proposed offensive actions to achieve victory, for which air power was an excellent weapon due to its ability to magnify the advantages of the offensive, and minimize or even nullify the advantages of the defensive.[265] Consequently, he opposed Clausewitz for whom defence was the stronger form of combat. The guiding principle for bombing was based on complete destruction of the objective in one attack in order to achieve moral and material effects, the repercussion of which would become tremendous. Since Douhet did not differentiate between military and non-military objectives, he suggested targeting industrial and commercial establishments, important private and public buildings, transportation infrastructure, and centres of civilian population. For bombs he advocated a mix consisting of explosives, incendiaries and poison gases that should be dropped as uniformly as possible over a given area. He also advocated aerial offensives "not only against objectives of least physical resistance, but against those of least moral resistance".[266] He regarded offensive aerial actions so devastating that the enemy's physical and moral resistance would collapse. Command of the air meant for Douhet victory based on *mathematical* certainty. He proposed striking the enemy by air power in the air, at bases of operation, and at production centres. For him excluding the army and navy meant

---

[262] Liddel Hart (1967), p. 360; Douhet, p. 20; Overy, Richard J.: *The Air War 1939-1945,* Stein and Day Publishers, 1981, p. 18; Budiansky, Stephen: *Air Power, From Kitty Hawk to Gulf War II: A History of the People, Ideas and Machines that Transformed War in the Century of Flight,* Penguin Books, 2003, p. 139; Earle, pp. 108-109.

[263] Pape (1996), pp. 13, 18.

[264] Douhet, pp. 3-10.

[265] Ibid., pp. 12-15.

[266] Clausewitz, p. 585; Douhet, pp. 20-22.

achieving swift and crushing victory on the battlefield with least casualty and a minimum of means involved.[267] Regarding an independent air force he differentiated between two functions:

- Units of bombardment had to possess sufficient striking power to achieve significant results by destroying the target completely. For one unit of bombardment he proposed ten planes, which made attacks more effective and painful, thus paralyzing all human activity.
- Units of combat had the task of clearing out aerial opposition that may cross the path of bombers in a mission.[268]

He wanted to achieve effects on the enemy through aerial offensives, concentrated in time and space. Douhet did not propose any rules regarding the choice of enemy targets. However, he saw target selection as the most delicate aspect of aerial warfare, which depended upon a number of circumstances including material, moral, psychological, and other factors the importance of which cannot be easily estimated. His aim was to smash the material and moral resources of the enemy until all social organizations collapsed. Despite the horror of such warfare he assumed that it might involve less bloodshed in the long run.[269] In order to attain maximum effectiveness he regarded the thorough co-ordination of land, naval and aerial forces as paramount. War was for him fought in masses, composed of men and machines, in which an independent air force must attain two strategic goals namely, achieving command of the air and crushing the moral and material resistance of the enemy. The key elements of his theory were the destruction of the enemy air force on the ground, achieving air supremacy and taking war directly to the heart of the enemy. Thus air power was the ultimate strategic weapon and strategy defined by its destructive potential.[270]

6.1.2 Winged Defence – Mitchell

The American proponent of air warfare, William "Billy" Mitchell, saw the aeronautical era of mankind approaching, which would subjugate the atmosphere. As he wrote, the arrival of the aircraft "set aside all ideas of frontiers … and, in case of war, one place is just as exposed to attack as another place."[271] He built on Douhet's ideas and emphasised the use of explosive bombs and poison gas in order to make the enemy evacuate his population centres and cease industrial production. However, unlike Douhet he thought that with the rapidity of technological advances only the threat of aerial bombing would be sufficient. He pledged the importance of achieving air supremacy that enables airplanes to fly over the enemy's territory at will. He also believed that aerial bombardments could make wars not only much sharper, but also more decisive and shorter. Mitchell did not see the people as important targets, but rather the centres of production such as "means of transportation, agricultural areas, ports and shipping … [that]

---

[267] Douhet, pp. 24-31; McPhil, Lambert/Andrew P. (Gr. Capt.): *Shattering Impact: The Psychology of Air Attack,* in: Hallion, Richard P. (ed.): *Air Power Confronts and Unstable World,* Brassey's, 1997, pp. 83-109.

[268] Douhet, pp. 35-46

[269] Ibid., pp. 49-68.

[270] Ibid., p. 99; Malik, p. 40.

[271] Mitchell, William: *Winged Defense, The Development and Possibilities of Modern Air Power – Economic and Military,* G. P. Putnam's Sons, 1925, pp. 3-4 (quotation p. 4); See also Mitchell, William: *Memoirs of World War I,* Greenwood Press, 1975, pp. 18-20.

cannot be replaced in the usual length of a modern war."[272] Victory depended on the amount of air power produced and applied as aerial bombardments were for him the "most accurate method of hurling a missile".[273] Air power has a decisive impact on the enemy's capability and will to fight since air battles would be of so far reaching effect that the nation loosing them could do nothing, but to capitulate without resorting to further contest. He regarded air power as a punitive element of the first order that could fly straight to the heart of the enemy country and destroy its capacity to make war in an incredibly short time. Air power makes it possible to attack any human population centre ranging from large cites down to a simple hamlet, and once the control of the air was established its effect was terrific, cumulative and constantly becoming greater. He envisioned the air force as an independent service, established to attain victory first in the air and then to destroy enemy establishments on the ground. He advocated a mixed air force composed of fighter, pursuit and bomber airplanes that possessed the ability for both offensive and defensive applications. Air power was for him a strategic weapon, but not the ultimate one.[274] Mitchell envisioned the enemy country as an integrated and mutually supporting system, susceptible to sudden destruction and laid the foundation of the *industrial web theory*. In order to exploit the air fully, he suggested employing the air force on the strategic level aimed at achieving strategic level effects. He also proposed destroying the enemy's war-making capability and questioned the need to defeat his army in the field. According to Mitchell the airplane was able to fly directly to the enemy's heart to paralyse any form of resistance.

6.1.3 Attacking Bottlenecks – Army Air Corps Tactical School

Faculty members of the AACTS took Mitchell's ideas further by extending his theory. They assumed that the delicate balance of interdependent segments within national structures could be offset by air power in order to break civilian moral. Their assumption was that through the destruction of selected targets it would become possible to disrupt the enemy's economy, which both discommodes his population in its daily existence, and brakes the faith in the military establishment. Applying pressure to certain vital links and nodes can create an imbalance that leads to the collapse of enemy morale, and paralyses economic factors essential for waging war. This assumption received a considerable boost with the introduction of the then-superior B-17 and the advanced Norden Mark XV bombsight equipment, despite the fact that the effect they might produce had yet to be determined. The basic assumption was that victory in war comes as a result of disrupting national life quickly and efficiently. The enemy nation was regarded as an interlaced web and it was assumed that dislocations would produce disturbances since industrial capacities are neither separated, nor disconnected.[275] This systemic approach regarded nation-states as interconnected economic systems with detectable critical points. It was thought that the destruction of these points through high-altitude precision bombing could achieve strategic

---

[272] Mitchell (1925), pp. 5-10, 16-17 (quotation p. 17).

[273] Ibid., pp. 31-36, 56-76 (quotation p. 56).

[274] Ibid., pp. 120-138, 171, 221; Malik, p. 41.

[275] Meilinger, Philip S. (Col.): *Airmen and Air Theory, A Review of the Sources,* Air University Press, Maxwell AFB, 2001, pp. 109-114; Perret, Geoffrey: *Winged Victory, The Army Air Forces in World War II,* Random House, 1993, pp. 20-32, 87-103; West, Scott D.: *Warden and the Air Corps Tactical School, Déjà vu?,* School of Advanced Airpower Studies, Air University Press, October 1999, p. 6; Finney, Robert T.: *History of the Air Corps Tactical School 1920-1940,* Research Studies Institute, USAF Historical Division, Air University, March 1955, pp. 27-37.

effects.[276] Attacking those vulnerable elements, also called *bottlenecks* reveals the greatest cumulative effect on the enemy's economic structure. In order to destroy the right elements they proposed that intelligence should not only be in the realm of sheer military activity, but must rest on the collaboration of economists, statisticians, and other area experts. This approach was based on indirect attacks on the enemy through his economy, with the assumption that attacking economic facilities leads to victory through disorganisation and dislocation. Identifying and disabling such facilities within the economy is critical in weakening the enemy's collective will. Although nations differ both in vulnerability and structure, it was thought that a thorough analysis could reveal those critical elements, which support the enemy's will to resist. For such theorists air power could be applied as a force that can efficiently solve policy disputes on its own through daylight offensive precision bombardments. The emphasis on daylight precision bombardments requiring no fighter escort achieved a dogma-like status, and was not abandoned until the clear demonstration of its failure in 1943.[277] Members of the AACTS believed in the ability of air power to break down the enemy's will and capability to fight, either by destroying the web of organic industrial systems in the enemy's interior, or by paralysing organic industrial, economic and civic activities. Whereas the first was responsible for the armed forces in the field, the second provided for the existence of the enemy nation. Air power was seen as able to destroy those critical systems that were crucial to other industrial branches, and the population such as "production and distribution of electricity, fuel, food, and steel: transportation networks: and certain specialised factories, especially those producing electrical generators, transformers and motors".[278] A small amount of carefully concentrated destruction of critical nodes was assumed to be enough to cause the fragile economic system of the enemy to collapse. This paralysis could shatter the will of the people so much that they would stop fighting and force the government to surrender.[279]

6.1.4 Victory through Air Power – de Seversky

For the American strategist, Alexander de Seversky, aviation was a paramount and decisive factor in war-making. As a swift and destructive weapon it also influenced tactics and strategy. He regarded air power a dynamic and expanding force that spoke a strategic language requiring the capability to out-build, out-think and out-plan any potential enemy. Similar to the members of AACTS, air power was for him a weapon that could strike at the enemy nation's nerve centres and jugular veins. He believed that a total war from the air was possible and that such a war did not proceed piecemeal since the whole enemy country was regarded as a target. For him, war was no longer seen focused on occupation, but destruction that should be *systematic* and *scientific*. Instead of being dragged into a mutual slaughter of soldiers, genuine air power could make the short cut that comes as a result of an all-out aerial assault on the enemy. Air power indicated to him that mankind arrived at the age of tri-dimensional warfare in which air

---

[276] Belote, Howard, D. (Maj.): *Warden and the Air Corps Tactical School, What Goes Around Comes Around,* Airpower Journal, Fall 1999, p. 40.

[277] West, pp. 8-9, 19-25; Perry, James D.: *Air Corps Experimentation in the Interwar Years – A Case Study,* Joint Forces Quarterly, Summer 1999, pp. 43-44, 47-48; Slessor, John C.: *The Central Blue, Recollections and Reflections,* Cassell and Company Ltd., 1956, p. 371.

[278] Quotation in Belote, p. 42.

[279] Pape (1996), pp. 62-63.

dominance provides for a solid and impregnable roof.[280] Aviation as a new weapon altered the principles of war and by opening a new and vast sphere of conquest it became the key to modern strategy. He dismissed the idea that air power alone could not achieve definitive victory over an enemy. He firmly believed that a nation could be forced to surrender from the air alone for which he suggested the following prerequisites: sufficient combat power to eliminate and neutralize enemy air power; correct and intelligent choice of vital targets against industrial centres, especially those of the aviation industry; adequate bombing power mostly expressed in load-carrying capacity; commitment in the form of continuity of action and endurance of effort.[281] For de Seversky, the advent of aerial warfare widens the choice of method since it either reinforces the traditional patterns of war such as invasion and occupation, or strikes at the enemy as a totality. This way the enemy's entire war potential could be disarmed directly and reduced to a helpless mass without the need for an invasion and mile-by-mile conquest. Although he differentiated between war of possession and war of elimination, air power meant more efficiency in both. Whereas large-scale demolition carried out by army units would look like horrifying vandalism, aerial bombing as a kind of technical preparation or softening.[282] Consequently, air power brought some new principles into the *science of war-making*, such as any kind of operation requires control of the air, and an umbrella provided by air power is the minimal condition in any surface warfare. Furthermore he claimed that only precision bombing aimed at planned and predetermined military and public facilities can destroy enemy morale from the air. Aerial blockades that systematically wreck the implements and channels of normal life can brake down both the enemy's will and ability to fight. For de Seversky aviation was, the first and foremost firearms of the twentieth century and deserves a prime position in modern warfare.[283]

6.2 Shattering Enemy Morale

Punishment rested on the assumption that by bombing the population as a homogenous, passive mass, it would revolt against the government demanding surrender. As depicted in Figure 6, the primary effect sought was psychological assuming that victory "w[ould] lie with whichever side first gains the moral objective."[284] The mechanism aimed either at achieving psychological effects directly through the use of area weapons such as incendiary bombs and poison gases, or indirectly through shortages caused in basic public services. Air power was regarded as a psychological tool and the idea of aerial warfare slowly became an all-encompassing credo possessing decisive and transformative power. Loose ideas turned into dogma as numerous publications detailed how to achieve victory through psychological effects aimed at changing behaviour.[285] The focus on destruction explains why the theorists never really quailed at the notion of the mass killing of civilians and as a logical consequence bombings delivered no escape from the horrors of the trenches of World War I. Not for the soldiers who

---

[280] Seversky, Alexander P. de (Maj.): *Victory Trough Air Power,* Simon and Schuster, 1942, pp. 3-41.

[281] Ibid., pp. 47-73.

[282] Ibid., pp. 100-104.

[283] Ibid., pp. 121-149.

[284] Quotation in Liddel Hart (1925), p. 42.

[285] Budiansky, pp. 132-136.

flew the planes in the air and much less for the civilians who experienced the bombs on the ground below.[286]

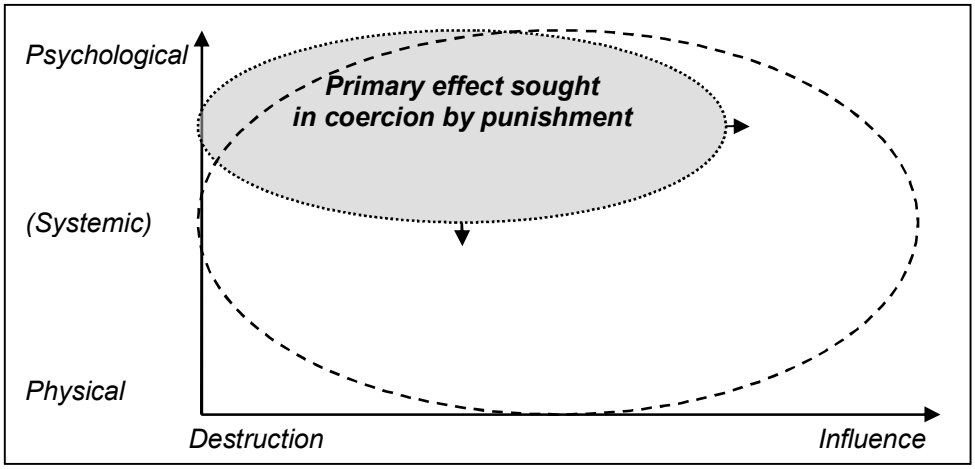

Figure 6 Primary effect sought in coercion by punishment

In general punishment can be considered as an attempt to make war fit a mechanism, instead of developing a mechanism that fits the characteristics of war. A constant over-estimation of the capability of air power contributed to didactic and rationalist strategies based on unilateral actions with standards and methods applicable to all wars. Minimum attention was paid to the context since the assumption that maximum force always results in maximum effects was never questioned. One explanation for this bias is that there was simply no proven knowledge regarding aerial warfare at that time. Plans for employing air power and assumptions regarding their probable strategic effect had no practical experience of what the bomber really can and cannot do, in modern wars. Achieving psychological effects was always the equivalent of hitting morale. In the end punishment theories failed because "threats to inflict harm on civilian populations by conventional bombing have never forced an adversary to abandon important goals."[287]

6.2.1 Reality Check

The consequence of punishment in World War II was that there was no difference between the home front and the war front. The reality of war became a first-hand experience both for civilians and soldiers alike. However, the large-scale bombing campaigns of the 20th century showed that the morale of any given society can be quite resilient, even under harshest consequences. Air raids against Germany obviously damaged the prestige of the Nazi regime, but the political conditions were never close to the desired collapse in terms of war-willingness, sought so

---

[286] Liddel Hart (1946), p. 15; Budiansky, p. 330; Meilinger, in: Hallion, p. 57; Luttwak, Edward A.: *Strategy, The Logic of War and Peace, Revised and Enlarged Edition,* The Belknap Press of Harvard University Press, 2001, pp. 174-176.

[287] Faber, Peter (Lt. Col.): *Competing Theories of Airpower: A Language for Analysis,* Internet, accessed 15. 06. 2004, available at http://www.airpower.au.af.mil/airchronicles/presentation/faber.html; Slessor (1956), p. 204; Quotation in Pape, Robert A.: *The True Worth of Air Power,* Foreign Affairs, March/April 2004, p. 124.

desperately by Allied commanders. In the case of Japan where bombing lowered both the morale of the population and the willingness to work, surrender was an open discussion, but there was no attempt to overthrow the regime. A British study examining the effects of bombardments in Hull and Birmingham also concluded that despite the damage, the overall willingness of the workforce to work was not affected.[288] Contrary to the assumptions of the industrial web theory, economies were able to recover surprisingly fast. National industries were sufficiently resilient and robust to accept strategic bombardments. Due to the German military success in 1941 thousands of Soviet industrial facilities were destroyed or abandoned. The overall output sank to a fraction of the level before the invasion, and the economy faced a complete collapse. However, Soviet industrial output was able to supply nearly three-quarters of weapons and almost all of the iron and steel in 1942. Despite the immense disaster at the beginning of the war and the fact that the rest of the economy remained as critical as of 1941, the output of each worker in the war industry increased up to three-times during the war. German industrial output, despite the heavy bureaucratic structure and increasing losses due to attrition on the fronts, and relentless Allied bombings, peaked in September 1944. In the end even firm believers of punishment had to admit that air power might be the first decisive of factors, but it was never decisive in itself. Thus anticipations regarding its decisive effects were disproved by events, even when the original concept of precision bombing was abandoned and cities saw wholesale carpet bombings.[289]

6.2.2 Destruction, not Decision

World War II showed that punishment as mechanism was more destructive than decisive. It successfully contributed to the process of attrition, but did not produce the expected psychological effect in the form of a quick collapse of enemy morale. Strategic bombing campaigns attacked the foundations of civilized life as the bomber offensive could only be expected to be decisive in the long term. Regarding industrial performance the bombing campaigns certainly lowered the maximum possible output, but never reduced the overall output until the very end of the war.[290] National identity and cohesion are powerful driving forces for accepting great sacrifice in which economic and social suffering is regarded as part of business during wartime. Even the heaviest bombings with conventional weapons can kill only a small percentage of the population. Evacuation, relocation and other counter-measures can further cushion the effects of punitive action. There is also a huge difference between personal frustration and collective rage as political alienation is often more important than economic hardship and deprivation.[291] Punishment based on aerial bombardments assuming that air power could do it alone, proved to be a dead end. As examples showed the only way bombing could destroy anything, was to destroy everything. In the end cities became the target and not factories. The physical was attacked as nobody thought of the psychological. This inefficiency

---

[288] Budiansky, pp. 284, 308; Overy (1981), pp. 122, 125.

[289] Overy, Richard J.: *Why the Allies Won,* W. W. Norton and Company, 1995, pp. 181-182, 199-207; Slessor (1954), p. 12; Liddel Hart (1946), p. 73.

[290] Liddel Hart (1946), pp. 27-32; Slessor (1956), p. 368; Mann et. al. (2002), p. 19.

[291] Pape (1996), pp. 21-24.

can be greatly explained by the fact that people can adapt and accommodate to worsening living conditions as long as the process is gradual.[292]

6.3 Risk – Nuclear Weapons Theory

The second school is risk. Unlike punishment, risk as mechanism is associated with the existence of the nuclear weapon. The period between the end of World War II and the demise of the Soviet Union is often seen as a period of simple nuclear deterrence. The atomic bomb forced theorists to developed new ideas in terms of mechanism. As both superpowers possessed nuclear weapons, a total war without any regard to possible consequences was not feasible. All-out nuclear wars based on large-scale bombardments were considered as mutually suicidal.[293] The focus shifted more to issues regarding how to negotiate, and not how to act. Not the sheer existence of the atomic bomb became important, but its effects on the traditional pattern of war that governed the adjustments of states in terms of their relations. It was assumed that the arrival of the atomic bomb changed the main purpose of the armed forces as from then on their existence was aimed at avoiding, and not winning wars. The emerging school of risk focused on achieving a right balance between clarity and ambiguity, rationality and irrationality, credibility and capability.[294] Its mechanism aimed more at affecting the enemy's perception and not his capabilities. The emphasis shifted towards apportionment and timing, which were seen as crucial elements in the employment of force. Risk indicates that the civilian costs of defying are inflicted gradually as operations escalate slowly in intensity and geographical extent, interrupted only temporarily as a result of the enemy's reactions.[295]

6.3.1 Absolute Weapon – Brodie

According to the American military strategist, Bernard Brodie, the airplane added only a new dimension to the battle and to the traditional patterns of war. However, the atomic bomb increased its potential enormously as even a single aircraft equipped with such weapon could inflict an unprecedented amount of destruction on the enemy. He regarded the atomic bomb as an epochal invention in the history of military technological developments, which introduced a greater economy of destruction, and turned strategic bombing the dominant form of future wars. The amount of destruction inflicted on the enemy is bound to be decisive, which renders other kind of military operations mostly superfluous.[296] The sheer destructive potential requires politicians, who can control their emotions and keep only a moderate amount of adversity. Brodie did not regard fighting as glamorous and emphasised negotiation over action, caution over boldness and reflection over feeling. The presence of the atomic bomb meant that basic decisions about wars had to be made in peacetime. In the case of war everything would be

---

[292] Budiansky, pp. 285, 309; Liddel Hart (1946), pp. 25-26; Sherry, Michael S.: *The Rise of American Air Power, The Creation of Armageddon,* Yale University Press, 1987, pp. 23-46, 251-255.

[293] Brodie, Bernard: *The Influence of Mass Destruction Weapons on Strategy,* Lecture before the Army War College, RAND P-669, 21 March 1955, pp. 5, 12; Pape (1996), p. 18; Liddel Hart (1946), p. 85.

[294] Brodie, Bernard: *War in the Atomic Age,* in: Brodie, Bernard (ed.): *The Absolute Weapon: Atomic Power and World Order,* Harcourt, Brace and Company, 1946, p. 23; Brodie, Bernard: *Implications for Military Policy,* in: ibid., p. 76; Krause, p. 125.

[295] Pape (1996), pp. 18-19.

[296] Brodie, Bernard: *Strategy in the Missile Age,* Princeton University Press, 1959, pp. 147-166.

much too late. Approaches that rest on traditional military virtues such as seizing initiative to carry the fight to the enemy must be replaced by other and better ideas. The strategy of deterrence was aimed at limiting the tolerable amount of destruction. The emphasis was on avoiding total thermonuclear war at almost any cost since such wars would not permit survival. Deterrence stands for the status quo and the importance of becoming aware of attendant risks and taking them into account properly. It acquires a special connotation since deterrence differs markedly from all-out wars in several respects. It must rely on an absolutely effective threat, which is never allowed to break down. This requires a retaliatory instrument that is never called upon to function though its efficiency and readiness must be maintained. In other words, deterrence rests on a system, which is always ready and permanently unused. Thus deterrence does not depend on superiority per se.[297] Deterrence is not absolute either, but only relative and its effectiveness must be measured based on the power it holds in check and the incentives to possible aggression. In the age of the thermonuclear bomb the deterrent value of an inferior force is much greater than in earlier epochs of history. The increase of its effect is less than proportional to the increase in potential destruction. Each unit of additional damage progressively diminishes the increments of deterrence. Deterrence takes place in the psychological domain and much depends on the other side's actions. Deterrence deliberately plays with the uncertainty coming from the enemy's mind. Although gain cannot be measured in the simple amount of damage, the degree of incentive to aggression is at the heart of deterrence. The size and efficiency of the armed forces manifest in the physical domain do not matter. What is important is the way those forces manifest themselves in the psychological domain of the enemy's thinking regarding how those forces will be used. Deterrence means that the enemy must expect a certain amount of vindication and irrationality in case force will be used, preferably against his major centres of population. Logically, should war erupt he suggested developing super dirty bombs that produce the maximum amount of radioactive fallout in order to achieve maximum effect.[298]

6.3.2 Exploiting Uncertainty – Schelling

The American economist and strategist, Thomas L. Schelling, saw war as a confusing and uncertain activity in which due to the involvement of fallible human beings, the outcome is highly unpredictable. Consequently, he understood international relations as a competition in risk-taking, a test of nerve, a large-scale game in which victory is achieved as much by trick as by merit. Issues in the international arena are decided not by the force that can be brought to bear, but by the eventual willingness to bring more force to bear if need be. Manipulating the shared risk of war means exploiting the danger that one opponent could go over the brink and drag the other with him. He admitted that such manipulation contains the risk of escalation.[299] Similar to Brodie, Schelling emphasised the psychological dimension of the conflict in order to modify behaviour through the employment of both threat and the actual use of force. He suggested targeting the enemy's government and population in a two-fold application of force, as brute force and coercion. In order to win wars he regarded demonstrations and bargaining much more important than target destruction based on local tactical purposes. Target selection should not

---

[297] Ibid., pp. 264-278.

[298] Ibid., pp. 279-295.

[299] Schelling (1976), pp. 93-94, 99-104, 116-117.

be based on tactical importance, but on influencing the enemy's perception about one's intent and the character of war. The difference was not in the sheer number of destroyed targets, but in the perception of risks and intent, which all influence the conduct or termination of war. Extra targets destroyed are just noise that distorts the message, since war never involves only antagonism, but also co-operation.[300] Thus armed forces had to be used either to hurt or destroy value, in order to change behaviour and induce co-operation. Consequently, war meant for Schelling both hurting and damaging the value system of the enemy on the strategic level. The outcome is more determined by the manipulation of risk rather than by the actual use of force. Although he emphasised deterrence, he also stressed that compellence could convince the enemy to accommodate. Military force had to act as a source of pain in order to make threats credible. Waging war required knowledge about the enemy's painful areas and a force that could inflict punishment in a gradual way. The power to hurt must induce cumulative losses, which should be more unattractive than the war is worth, or induce the enemy into making concessions, compromises or limited manipulations.[301] Actions must aim at inflicting loss of value by raising the costs until the enemy comes to terms. War must be conducted in measured doses in a gradual, deliberate, and less concentrated fashion. Schelling regarded hurting as an indirect action that depends more on threat than on damage already done. He also demanded restraints in war because risk aims at exacting good behaviour and obliging discontinuance of mischief, but not destroying the enemy altogether. Threat obviates the need for the actual use of force, in which only a minimum amount of force is required in order to initiate fear of future attacks. Schelling did not exclude that the enemy can value the armed forces rather than the economy, but made a clear difference between coercing the enemy's government and his population. Coercion must be directed against things the adversary values most. Consequently, he always emphasised the difference between civilian or non-military targets and civilians themselves.[302]

6.4 Weapons Unused

Schelling was convinced that few parts of the world were worth of a serious war. However, defending such parts or running risks in order to protect them might preserve commitment to act elsewhere and at later times. Risk-based military coercion is also biased towards the strategic application of air power. However, it reflects the existence of the nuclear weapon and its effect, which is not that it will make war more violent, but it concentrates violence in terms of time. This overwhelming power rendered the aspect of precision irrelevant and as a consequence, targeting did not go beyond vague categories. The assumed causal relationship between aerial attacks and political outcome rested on the overwhelming physical and psychological power of the atomic bomb, which did not encourage the re-examination of old strategic bombing dogmas.[303] The prospect of a nuclear war was an excellent background for achieving

---

[300] Schelling (1976), pp. 112, 113, 120; Clodfelter, Mark: *The Limits of Air Power, The American Bombing of North Vietnam,* The Free Press, 1989, pp. 73-117, 147-176.

[301] Schelling (1976), pp. 166, 167; Whittemore, David M. (Maj.): *Modelling Strategic Effects in Wargames,* Air Command and Staff College, Air University Press, April 1999, pp. 7-9.

[302] Schelling (1976), pp. 171-174.

[303] Schelling, p. 124; Brodie (1946), p. 71; Budiansky, p. 349.

psychological effects on the enemy despite the fact that risk requested a weapon that should never be used. The real value of influencing the enemy in order to induce a behavioural change was in the threat that such weapons embodied.[304] Terms such as mutual assured destruction reflected the idea that a full-scale atomic war or even a limited version of it would run counter to national interest as risk focused on the same categories and assumed the same mechanism as punishment. Massive damage simply meant reducing leverage. The real value of risk lays in its potential to signal that future damage will come, and cease only if the enemy complies with the demand.[305]

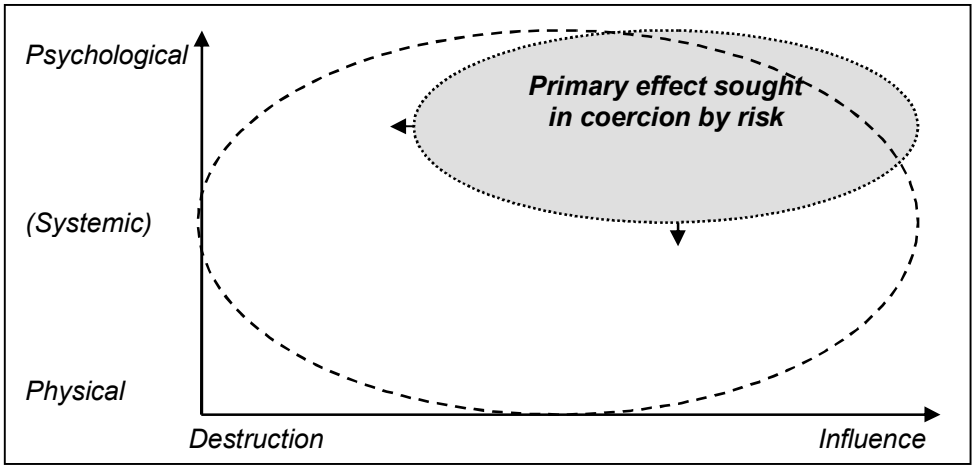

Figure 7 Primary effect sought in coercion by risk

Whereas punishment was intended to get to psychological effects in the fastest possible time without taking care whether the hostage was alive or not, risk focused very much on keeping targets such as the enemy's population and economy alive as long as possible. Although risk aims at the same targets as punishment, it slowly raises the amount of destruction. The key is to inflict damage at a gradual rate rather than destroying the target at once. Risk acknowledges that effects must be achieved in a nuclear age in which wars are fought to be terminated, but not terminated definitively. Compared with punishment, risk is a rather defensive approach that emphasises deterrence in order to make the enemy accept certain conditions. It is not re-establishing the status quo by using military means, but preserving it and signalling the possibility of further interventions by military means. It is punishment-by-timing since it attempts to inflict costs at a gradual and increasing rate.[306] As Figure 7 displays, similar to punishment the primary effect sought in risk was also psychological, but due to the absolute character of the nuclear weapon, destruction was not seen as a viable mean. The exclusive focus on influence indicates that risk seems to be less effective than punishment. Damage in the future instead of the present appears to be a weak coercive leverage. Wars in Vietnam and Korea showed that actual damage can be quite high with conventional weapons, but it is physically impossible to kill

[304] Budiansky, pp. 363-365.

[305] Pape (1996), pp. 66-67.

[306] Pape (1992), pp. 439-441; Brodie (1946), p. 92.

all of the enemy's population and industry. Apart from the time aspect and the means employed, there is no real difference between punishment and risk. As a RAND study examining the effects of military operations on Viet Cong behaviour summarised, enemy units could suffer considerable losses from surprise air attacks, but "in many instances bombing was either inaccurate or failed to inflict major casualties".[307] Threatened damage can also not exceed the actual damage imposed by punishment and its step-wise accumulation leaves chance to adjust. Risk simply leaves too many opportunities for the enemy to act, who can turn the situation to his advantage. Increasing damage gradually can also suggest loss of commitment, which can evaporate credibility. As the RAND study pointed out, bombing civilians was rarely a cause to revolt as during interrogations captives often denied that attacks on villages were a major cause to join the Viet Cong. Thus risk strategies can probably enhance the settlement of nuclear disputes when political constraints prevent a thermo-nuclear punishment campaign, but barely work in conventional crises and confrontations.[308]

[307] Quotation in Goure, Leon: *Some Impressions of the Effects of Military Operations on Viet Cong Behaviour*, RAND, RM-4517-ISA, August 1965, p. 8; Pape (1996), p. 28.

[308] Pape (1996), p. 28; Goure, p. 16; Pape (1992), pp. 440-441.

7 Battlefield Re-Orientation

In this chapter we introduce the last two schools of military coercion, which are decapitation and denial. As their names imply, these two schools focus either on decapitating the enemy or denying him the ability to use his armed forces properly. Despite their recent character, the roots of these two schools are deep. Whereas decapitation resuscitates many elements of classical air force theories advocating strategic bombing, the origins of denial can be found as early as in the works of some British strategists.[309] The major theorists we introduce in this chapter are Warden associated with the decapitation school of thought, and Slessor, Liddel Hart and Pape, all representing the denial school of thought.

7.1 Decapitation – War Based on Equation

Decapitation as a school goes back to the American Air Force officer John Warden. He can be seen an iconoclast to critics and a visionary to admirers. Warden became famous with his systematic approach that depicts the enemy in the form of five concentric rings.[310] According to him modern industrial societies possess resilient industrial facilities with no single key to achieve leverage. Consequently, the commander's most important responsibility is the correct identification and appropriate strike of enemy centres of gravity. The latter should be done by decisive blows that come as a result of air superiority. No state has lost a war while it was able to maintain air superiority, which is always the prelude to military victory.[311]

7.1.1 Strategic Warfare – Warden

Similar to most strategic bombing theorists, also Warden advocates the importance of air superiority. Key to it is for him materiel, personnel and position. Due to their combination any analysis is impossible and simplification is required. Similar to Douhet also he describes defensive operations as a negative concept since they delegate the initiative to the enemy. In detailing offensive operations he argues that the enemy's centre of gravity may be in equipment such as planes and missiles; logistics such as supply support; geography such as operational and support facilities; and personnel such as pilots and command and control facilities.[312] He regards the last to be the true centre of gravity which, if successfully destroyed or isolated, equals decapitation with serious or even fatal consequences. Although command and control facilities are resilient and difficult to destroy, three areas such as information, decision and

---

[309] Mets, David R.: *The Air Campaign, John Warden and the Classical Airpower Theorists,* Revised Edition, Air University Press, Maxwell AFB, April 1999.

[310] Warden, John A. (Col.): *The Enemy as a System,* Airpower Journal, Spring 1995, Internet, accessed 09. 10. 2002, available at www.airpower.maxwell.af.mil/airchronicles/apj/spr95.html; Gordon, Michael R./Trainor, Bernard E. (Gen.): *The General's War, The Inside Story of Conflict in the Gulf,* Little, Brown and Company, 1995, p. 77; An example for admiration is Murphy, Timothy G. (Lt. Col.): *A Critique of the Air Campaign,* Aerospace Power Journal, Spring 1994, Internet, accessed 14. 04. 2003, available at www.airpower.au.mil/airchronicles/apj/apj94/murphy.html.

[311] Warden, John: *The Air Campaign, Planning for Combat,* Pergamon-Brassey's International Defense Publishers, 1989, pp. 4-10.

[312] Ibid., pp. 13-15, 16-20, 34.

communication appear to be vulnerable. A successful attack on one of these spheres decreases the effectiveness of enemy operations as "even a slight disturbance … can be dangerous or … catastrophic."[313] Although all services can attack those centres of gravity, Warden thinks that only air power can circumvent enemy forces and attack directly.[314] He also emphasises that military operations must be conducted in a way that directly supports political objectives. Furthermore, military objectives and plans must be tied to political objectives as seen through the enemy's eyes. Military objectives generally fall for him into three categories such as destruction of enemy forces, the enemy's economy with its war-related components, and the will to resist. He asserts that direct attacks on the will of the population are difficult to carry out. The population is either more resilient than expected or has no influence on the government. However, once the objectives are identified, he suggests an in-and-out campaign, an indirect approach that does not focus on the enemy's armies and makes war shorter and cheaper in terms of blood and treasure. His suggestion is to go directly to the political centre of gravity and avoid direct encounters with enemy's forces. He sees air power as a key force and claims that in modern warfare orchestration and not subordination or integration of services is important. Gaining territory should not be regarded as an objective for the military since focusing on territory is beguiling, time deceiving, and the commander must be careful with both.[315]

7.1.2 Towards Hyper-War

He terms the approach to link political ends with military means *strategic warfare* that rests on deductive top-down thinking and proceeds from the big picture to the small. His early ideas on orchestrating war are further developed and summarised in a model depicting the enemy as a system of five rings. The rings are in concentric order *fielded military*, *population*, *infrastructure*, *organic essentials* and *leadership* as the bull's eye in the middle.[316] Strategic warfare focuses on the totality of the enemy in order to produce desired effects in which the clash of forces is only a means to an end, but not the end in itself. His approach rests on the assumption that the enemy is composed of numerous subsystems that can be affected to combine minimum effort with maximum effect. As Warden argues, clashes of fielded forces are the most costly and least productive in the majority of cases.[317] According to him, war can be depicted in the form of a simple equation in which the physical and moral components define the outcome.

---

[313] Ibid., pp. 44-47 (quotation p. 46).

[314] Warden, John: *Employing Air Power in the Twenty-first Century,* in: Shultz, Richard H. Jr./Pfaltzgraff, Robert L. Jr.: *The Future of Air Power in the Aftermath of the Gulf War,* Air University Press, July 1992, p. 61.

[315] Warden (1992), p. 67; Warden (1989), pp. 109-116, 117-127; Regarding obstacles and opportunities in seeing through the enemy's eyes see Gray, Colin S.: *Comparative Strategic Culture,* Parameters, Winter 1984, pp. 26-33.

[316] Warden (1995); Warden, John: *The New American Security Force,* Airspace Power Journal, Fall 1999, Internet, accessed 07. 06. 2004, available at http://www.airpower.maxwell.af.mil/airchronicles/apj/apj99/fal99/vorfal99.html; Warden, John A. III.: *Success in Modern War, A Response to Robert Pape's Bombing to Win,* Security Studies 7, Number 2, Winter 1997/98, pp. 175-185.

[317] Warden (1995); Warden (1992), p. 62; The idea behind strategic warfare was as early documented as 1943. FM 100-20 states that *"Objectives are selected in accordance with the ultimate purpose of the strategic plan."* Quotation in Field Manual 100-20, *Command and Employment of Air Power,* War Department, 21 July 1943, p. 9.

$$(Physical)x(Morale) = Outcome$$

Whereas the physical is theoretically knowable, the moral is beyond the predictable. Consequently, efforts must focus on the physical domain. Military objectives at the strategic level must have a political value that imposes paralysis upon the enemy on the highest level. He understands paralysis as changes to one or some parts of the enemy's physical systems in a way that he decides to adopt our objectives, because physical opposition is impossible for him. If any part of the system stops working properly it also affects all other parts. However, he also admits that there might be a delay between strategic events and subsequent tactical effects. In strategic warfare the entire enemy system is targeted, which starts with large entities and works downwards to small details as required.[318] Decapitation aims at enemy command and control by threatening it directly or through indirect pressures on the outer rings. Warden regards control of the enemy's command structure as the ultimate goal of military operations. By moving outward the redundancy of the enemy system grows and the chance of being dragged into a classical war of attrition and annihilation increases. He sees the purpose of war in doing something to the enemy's centre or to prevent him from doing something to ours.[319] Affecting the bull's eye either forces the enemy to make concessions, or he is no longer able to pursue actions. Unfortunately, he asserts that threatening the command element directly is not always possible and indirect pressure must be applied to make the enemy realise that further actions are impossible and he is unable to continue with combat activities. He terms this sort of war the *hyper-war* that capitalizes on advanced technology, precision in hitting the target, and surprise at the operational and strategic levels. Hyper-war expresses the ability to attack all of the enemy's key operational and strategic nodes near-simultaneously. In this sort of war we achieve strategic paralysis through parallel attacks by hitting targets in a single blow, which makes an effective response impossible. It is just the opposite of the traditional serial warfare, which makes him conclude that the history of warfare has eventually arrived at the age of the airplane.[320]

7.1.3 Axiological Targeting

Warden's systemic approach soon became popular in the air force community and resulted in an abundance of clones and modifications.[321] Among others it was refined and made more focused also by Wijninga and Szafranski. They assume that unlike during the Second Wave when dominant mechanisms and measurements for air targeting were based only on utility, in the Third Wave the focus will move beyond utility targeting aimed at things that enemy leaders value. The enemy is also for them reducible to targeting templates, but they emphasise that it is equally important to realise that the enemy is a complex human organisation. Their composite model combines Warden's five rings with Maslow's hierarchy of needs in order to show that value targeting of leadership at every level of war and utility targeting of military assets is the right combination. This way the enemy is equally affected in the material and non-material

---

[318] Warden (1995); Warden's equation is Clausewitzian who regarded war as a destructive test expressing "physical and moral strength. Whoever has the greater sum of both left at the end is the victor". Quotation in Clausewitz, p. 274.

[319] Warden (1992), p. 63; Warden (1995).

[320] Warden (1992), pp. 64-65, 78-84.

[321] See Felker, Edward J. (Lt. Col.): *Airpower, Chaos and Infrastructure, Lords of the Rings,* Air War College, Air University, Maxwell Paper No. 14, Maxwell AFB, July 1998.

domains. Axiological targeting capitalises on attributes of the Third Wave with its global connectivity. Whereas utility targeting engages objects which are of value in the physical domain, value targeting is aimed at the minds and needs of leaders. Utility targeting denies functions, value targeting deprives needs and due to their combination the enemy declares cessation of fighting as a desired effect. In sum, axiological targeting regards non-military centres of gravity as more important and counter-value targets as more strategic than counter-force targets.[322]

7.2 Strategic Bombing Revitalised

Decapitation is the culmination of earlier strategic bombing ideas wrapped in a different and more sophisticated vocabulary. It is a theory that resuscitates old ideas of strategic bombing by injecting new technology and terminology into it. The enemy is not one mass with only two vague strategic vulnerabilities such as population and economy, but a system depicted as interlinked concentric rings. This approach also regards the enemy mechanistically as a passive collection of targets that can be reduced to simple templates.[323]

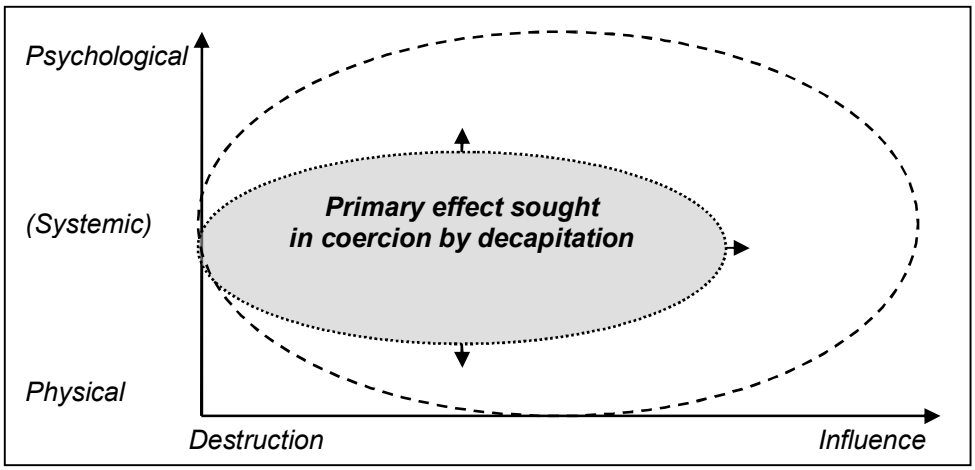

Figure 8 Primary effect sought in coercion by decapitation

Similar to strategic bombing theories decapitation offers only insufficient tools to grasp the enemy's true nature with his social contours and the way he organises for war. It is a schematic representation, a disembodiment that rests on five tangible and discrete categories assumed to be constant during war.[324] In general Warden's ideas reflect both the political changes that

---

[322] Wijninga, Peter W. W. (Col.)/Szafranski, Richard: *Beyond Utility Targeting, Toward Axiological Air Operations,* Aerospace Power Journal, Winter 2000, pp. 47-56; Kan, Paul R. Dr.: *What Should We Bomb? Axiological Targeting and the Abiding Limits of Airpower Theory,* Air Power Review, Volume 7, Number 3, 2004, p. 33.

[323] Budiansky, p. 413; Ware, Lewis Dr.: *Ware on Warden: Some Observations of the Enemy as a System,* Airpower Journal, Winter 1995, Internet, accessed 07. 06. 2004, available at www.airpower.maxwell.af.mil/airchronicles/apj/ware.html.

[324] Soonthornkit, Saridporn (Wing. Com.): *Sun Tzu, Strategic Paralysis and Small Nations,* Air Power Review, Volume 4, Number 4, 2001, pp. 40-46.

resulted in fundamental reorganisation of the world, and the advent of a new military-technological revolution. Precision and stealth are the two main enablers of decapitation, which made Warden to assume that fighting is neither the essence of war nor a desirable part of it. For him the real essence of it is taking necessary actions to make the enemy accept our objectives as his objectives. As depicted in Figure 8, decapitation stands for a conceptual shift in military coercion theories as the focus moved from achieving psychological effects towards systemic effects in the physical domain. The aim is to paralyse the enemy on a strategic scale by inducing system-wide havoc and disturbance. According to decapitation destruction of the enemy's armed forces is desirable only if it leads directly to political objectives. The underlying assumption is that leadership acts like a body's brain. If it is destroyed the body dies, if it is isolated the body is paralysed, and if it is confused the body becomes uncontrollable.[325] In decapitation air force is regarded as a central service, a strategic instrument capable of organising its own military operations at all levels of war. Decapitation is based on the assumption that air power can create systemic effects beyond the scope of the geographically oriented surface battle. It does not need to proceed through the tactical-operational-strategic levels of war to fight a "prolonged duel of powerful weapons against even more powerful defense fortresses".[326] Decapitation means that air power can achieve systemic effects with theatre-wide significance just bypassing surface forces. Unfortunately, similar to the theories of the inter-war period also the mechanism upon which decapitation rests is more a "principled belief rather than … reason, and principled belief – however powerful or well intended – is by definition not susceptible to rational explanation."[327]

7.3 Denial – Achieving Imbalance of Forces

The last school of thought we introduce is denial, which indicates that inflicting sufficient pain on the enemy's society or decapitating the political and military leadership is simple beyond the capacity of conventional armed forces. In contrast to the previous three schools it is again surface-focused as the underlying mechanism seeks to ruin the feasibility of the enemy's strategy in terms of achieving his territorial objectives. Denial stands for compelling concessions to avoid futile expenditure of resources. It does not attempt to cause suffering to the population, but focuses on prohibiting the enemy from achieving his territorial objectives.[328] Although denial is not as consistent as the previous schools of thought, the approaches we introduce make it possible to discern a clear relationship with the three common elements of effects-based operations.

7.3.1 Air Power and Armies – Slessor

The Britain John C. Slessor, Marshall of the Royal Air Force, differentiated three types of war that had appeared since the eighteenth century. Whereas the first type was the classical war of battlefields and sieges, the second was the war of lines such as World War I. The third type was

---

[325] Warden (1995); Pape (1996), p. 80; For decapitation effects see Gordon/Trainor, pp. 312-321.

[326] Noedskov, K. (Maj.): *Systematizing Effect Based Air Operations,* Air & Space Power Chronicles, Internet, accessed 27. 09. 2002, available at www.airpower.maxwell.af.mil/airchronicles/cc/noedskov.html; Quotation in Douhet, pp. 12-13.

[327] Quotation in Ware.

[328] Pape (1996), p. 20; Pape (1992), p. 441.

the war of vast areas as waged in World War II. This type of war he also described as the first air war in which the enemy country itself and the population became the primary objectives of attacks. Although he believed that modern air power made the traditional meaning of the battlefield irrelevant, he thoroughly examined the relationship between air power and armies.[329] He saw the object of an air force in a land campaign in assisting and co-operating with the army in the field. Its aim is to defeat the enemy's army and air forces through destruction of his land forces, communications and system of supply. Slessor also paid attention to another aspect, which he regarded as the positive influence of direct air strikes on objectives on the ground. Once the enemy army was defeated he suggested the ultimate reduction of the enemy nation by air measures that could be directed against vital centres to put the population under unrestricted air actions. He regarded air superiority as the control of air communications with the aim to break down the resistance of the enemy's army. Otherwise, the air situation had for him no importance in any form of war, except of its effect on the situation on the ground. Successful air operations required a dynamic enemy since "air action against the communications and back areas of an enemy army cannot have a decisive effect unless that army is being forced to fight".[330] In order to achieve air superiority he suggested two principles:

- The resolute bombing of the enemy's vital centres, which destruction or even interruption can result in fatal effects in terms of continued vitality.
- Since he did not regard vital centres strictly as military assets he further proposed direct actions against the enemy's air forces to a varying degree.[331]

He assumed that the importance of vital centres might vary from time to time according to the strategic situation and claimed that the selection of appropriate objectives must rest on the most exhaustive use of resources and information. As he argued such a meticulous system of intelligence should involve all available political and industrial sources.[332] Air superiority could only be secured by offense with objectives falling into two main classes with distinctions becoming nebulous as soon as war starts. The first objective was fighting troops and meant killing in order to prevent the enemy to be in the right place at the right time or reducing his fighting efficiency by denying access to food supplies and various sorts of war material. Fighting troops could also be conceptualized broadly as lines of communication and headquarters. The second objective was supply, which he subdivided into rough headings such as production, which meant the movement of goods of every kind from source up to the area of operations, reserves of such material, and distribution throughout the lines of communications.[333] His concept of strategic air concentration was due to the fact that he underrated the effects of bombing on the morale of the civilian population. In a Clausewitzian fashion Slessor admitted that the moral effect is first and foremost dependent on the material effects. Thus air power should be used in a concentrated way to achieve a decisive effect for which he suggested fighting troops to be the primary objective and supply only in the case of relative military inactivity. Although he knew that material and machinery would play a great part in future wars,

---

[329] Slessor, John C.: *Strategy for the West*, Cassell and Company Ltd., 1954, pp. 10-13.

[330] Slessor (1936), pp. 1-10; Slessor (1954), pp. 113-114 (quotation p. 114).

[331] Ibid., pp. 12-17.

[332] Ibid., pp. 22-30.

[333] Ibid., pp. 61-64.

he regarded their production facilities as less vulnerable to strategic bombing since aerial offensives could only limit and reduce them.[334] He saw the role of air power mainly as creating difficulties where they do not exist, and to intensify them when they exist already. Thus air power had the capacity to limit the margin of safety on the line of communications of an enemy army.[335]

7.3.2 Indirect Approach – Liddel Hart

Another Britain, the military historian and strategist B. H. Liddel Hart, regarded the idea of a nation at arms a mere worship that stressed quantity over quality with national objectives achieved only by mass destruction. According to him victory is not an end in itself. It is useless if the end of the war finds the victor so exhausted that he is defeated in the peace. The true aim of war is to subdue the enemy's will to resist with the least amount of human and economic losses. The destruction of the enemy's armed forces is just a means, which questions the usefulness of a decisive victory in battle if the victor bleeds to death as a result of it.[336] Liddel Hart understood strategy as more than the sheer movement of forces. It meant for him simply *achieving an effect*. His idea concerning grand strategy was to direct and regulate all resources of a nation, all available instruments in a way that a better state of peace can result. Thus effects could only be achieved by sound calculation and co-ordination in terms of ends and means, which lead to a perfect economy of force.[337] He advocated the exploitation of movement and surprise representing the *physical* and *psychological spheres*. Only surprise can lead to advantageous circumstances in which serious fighting does not take place. In the physical sphere he named four effects that resulted through movement such as upsetting the enemy's disposition, separation of his forces, endangering his supplies and menacing his route of retreat. Liddel Hart thought that effects in the physical sphere would penetrate into the psychological sphere and cause the impression of being trapped. However, this can only be achieved through the line of least resistance in the physical sphere, which is equivalent with the line of least expectation in the psychological sphere. He suggested a preceding distraction that deprives the enemy of his freedom of action in both spheres. His famous *indirect approach* meant maximum possible concentration with minimum necessary force. He stressed that in order to hit with effect, adaptability is needed to operate along lines offering alternative objectives. He regarded cutting communications as extraordinarily important and presented the deduction that "the nearer to the force that the cut is made, the more immediate the effect; the nearer to the base, the greater the effect. In either case, the effect becomes much greater and more quickly felt if made against a force that is in motion, and in course of carrying out an operation, than against a force that is stationary."[338] He expected more success and more effects when cutting communications as far back as possible. Whereas the minds of enemy troops could be influenced by a stroke close in the rear, a stroke farther back would rather influence the commanders' mind. He praised the advent of new technologies from which he valued the air force as a contributing factor to dispersed strategic advance. Thus advancing forces should not be distributed as widely as

---

[334] Ibid., pp. 65-85.

[335] Ibid., pp. 90, 200-215.

[336] Liddel Hart (1925), pp. 9-10; Liddel Hart, Basil S.: *Thoughts on War,* Spellmount Staplehurst, 1999, pp. 19-20, 47.

[337] Liddel Hart (1967), pp. 335-336.

[338] Ibid., pp. 338-344 (quotation p. 344).

compatible with combined actions, but dispersed as much as compatible with cohesion. The effectiveness of armies meant paralysing the enemy's actions and not crushing his forces. Concentration meant for him waging one's own strength against enemy weakness as a fruit of calculated dispersion.[339] In connection with the arrival of tanks on the battlefield, he named their moral effect on enemy infantry that induced both mental and physical paralysis of the enemy's command.[340] In the airplane he saw the possibility of striking at the enemy's economic and moral centres to attain a direct end by the indirect application of means. He fully appreciated the mobility of the airplane and called it the *knight-move* into warfare:

- The combination of air power and increased ground mobility resulted in more effective achievement of economic and moral objectives. He believed that mechanisation both on the ground and in the air made an easier paralysis of the enemy's vital organs possible without the need to destroy him through hard fighting.
- He pledged for paralysis and striking civilian objectives deep in enemy territory. As he emphasised disorganisation and demoralisation both having paralysing effect on the enemy have always been well-understood by the masters of the art of war.[341]

His indirect approach anchored in the assumption that attacking the military's command, control and communications facilities paralyses the armed forces as a whole, which can overlap and disintegrate the nation behind. Contrary to the theorists of strategic bombing he assessed industrial bombing as less decisive than actions against military strategic objectives. Instead of striking the capital and other vital centres, Liddel Hart suggested disposing the enemy's main forces first. The enemy's air force must be defeated first face-to-face in order to realise any benefit. Later in the nuclear age he opted for indirect, strategic actions against military objectives and not industrial attrition. He always stressed the superiority of strategic operation over battle by stating that the true aim of war is not so much to seek battle as to seek an advantageous strategic situation, which does not in itself lead to victory, its continuation by battle can surely achieve this.[342]

7.3.3 Bombing to Win – Pape

According to the American political scientist, Robert A. Pape, the essence of denial is to cause an imbalance of enemy forces by hitting military targets in the enemy's homeland until he compels and modifies behaviour. Denial as a mechanism threatens to defeat the enemy's military adventure by reducing his military capacity to control areas. It suggests nothing, but suffering the costs of the conflict. The enemy cannot gain or hold the disputed territory since his strategy is targeted in order to undermine his confidence.[343] Denial stands for the application of military means in order to prevent the enemy from achieving his political goals. However, successful denial also requires the possession of superior military capabilities for achieving a decisive victory on the battlefield. Denial might not always work and there is no other option than

---

[339] Ibid., pp. 346-347.

[340] Liddel Hart (1999), p. 263.

[341] Liddel Hart (1967), pp. 358-359; Liddel Hart (1999), p. 233.

[342] Ibid., pp. 361-365.

[343] Pape (1996), pp. 5-10.

to inflict a decisive military defeat on the enemy.[344] Although denial reduces the probability that resistance will yield benefits and signals that not yielding involves the futile expenditure of more resources, no special efforts are made to cause suffering to the population.[345] Thus if the coercer wants to obtain more than he can compel, failure is inevitable even when denial is partly successful. The enemy is always flexible and ready to change his strategy in order to minimise or negate the coercer's actions. Consequently, denial focuses on particular vulnerabilities within the enemy's strategy for success as simply destroying targets has limited coercive value. Denial attempts to exploit the enemy's military strategy, which can be described either as conventional/mechanised or unconventional/guerrilla warfare.[346] The term *mechanised* refers to traditional attrition and annihilation warfare. The objective of such warfare is to destroy enemy forces through intense and extended battles along the frontlines. The focus is on inflicting losses and destroying cohesion among units and certain combat functions that are highly dependent on networked logistics and communications. The term *guerrilla* indicates units that are dispersed over a wide area and avoid decisive battles. In terms of denial, guerrillas pose a problem since coercers can obtain concessions only over a specific territory that has been denied to the enemy. Losing one territory does not mean losing another and demanding more than one can persuade the enemy means that coercion can eventually fail.[347] Regardless of the enemy's military strategy pressures must be constant over a considerable period of time. Giving the enemy breathing space means that he can improve his chances by regaining military capabilities or attracting new allies. Demonstrating capacity by force over the disputed territory also requires strong financial commitment.[348] In denial the enemy forces are attacked to the extent they become too weak to oppose friendly ground forces in seizing the disputed territory or to inflict high casualties. Thus campaigns can include attrition by destroying arms-manufacturing facilities, interrupting supplies and disrupting lines of communication.[349] Pape differentiates three kinds of denial.

- The first is support of ground units, in which the air force is applied as flying artillery. This strategy was employed during World War I, when the newly established air units tried to support the army in the field by dropping bombs from the air. The German *Luftwaffe* also pursued such a strategy later successfully in order to support combined arms assault to break through enemy lines.
- The second is strategic interdiction, which involves large-scale operations focusing either on destruction or isolation of enemy military production facilities. The aim of such operations is to reduce the quantities of enemy war materiel.

---

[344] Pape, Robert A.: *The Air Force Strikes Back: A Reply to Barry Watts and John Warden,* Security Studies 7, Number 2, Winter 1997/98, pp. 192-194; Pape (1996), pp. 12-15.

[345] Pape (1996), p. 19.

[346] Pape (1992), pp. 441-442; Pape (1996), pp. 30-31.

[347] Corum, James S./Johnson, Wray R.: *Air Power in Small Wars, Fighting Insurgents and Terrorists,* University Press of Kansas, 2003, pp. 423-439.

[348] Pape (1996), pp. 31-32.

[349] Ibid., p. 69.

- The third is operational interdiction aimed at inducing operational paralysis and includes actions such as attacking certain theatre-level combat support functions to reduce the enemy's ability to co-ordinate forces in the field.[350]

Altogether his conclusion is that denial strategies work much better against conventional mechanised forces than against guerrillas who are mostly immune to coercion. Coercers should often expect to pay the full costs of military success if they want to extract political concessions. In this case, he suggests attacking military targets instead of politically sensitive civilian centres to force the enemy to change behaviour. Denying the enemy his fielded forces at the earliest possible time means degrading his capacity to wage war. Denial stands for avoiding unnecessary destruction of the enemy's social and economic infrastructure, but in the case it fails denial can also bring the coercer closer to victory through the application of brute force.[351]

7.4 Smashing Enemy Forces

Denial-based coercion can be seen as the antithesis of punishment, risk and decapitation. It neither focuses on the enemy's population and economy, nor on his leadership. In its purest form denial is smashing enemy military forces and weakening them to the point where friendly ground forces can seize disputed territories without the danger of suffering unacceptably high losses. Denial campaigns focus on arms-manufacturing facilities, interdiction of supplies to the front, disrupting enemy movements and communication, and the attrition of enemy armed forces in the field. It accords with Clausewitz, who also assumed that the real key to the enemy country is his army. As he emphasised the annihilation of the enemy's military aimed at a considerable weakening can lead to the loss of a particular territory. The enemy must either be made literally defenceless or put in a position that increases this probability.[352] Denial is an approach that, similar to decapitation, rests on extensive application of precision weaponry, but focuses on a much wider set of targets. Instead of achieving full paralysis of the enemy, denial focuses on his armed forces through a combined application of ground and air power. As depicted in Figure 9, denial indicates a low level of ambition in terms of the mechanism selected and means applied to achieve physical effects through destruction. It stands for a careful attrition and annihilation in which air power is an effective and lethal complement to ground units to efficiently crush enemy armed forces. Attacks coming simultaneously from air and ground put the enemy in a quandary, and defeat him relatively rapidly and with few casualties.[353] Denial appears to offset the most important drawback of the air force. Although tactically air power is most rapid in operation and sudden in causing shocks, strategically it is less fitted to produce desired decisive effects. Consequently, aerial warfare always bears the chance to lead to attrition warfare on the strategic level. Denial means defeating the enemy's capacity to organize its resistance, which comes as a result of being concentrated around large ground forces.[354] It is based on significant ground forces even if they can occasionally be put into an air-support role. Thus ground forces do not

---

[350] Ibid., pp. 70-73.

[351] Ibid., pp. 74-80.

[352] Ibid., p. 69; Clausewitz, pp. 85, 554, 586.

[353] Pape (2004), pp. 117-120.

[354] Liddel Hart (1946), p. 25; Pape (2004), p. 127.

swarm around the enemy, but confront his units head-on in a Clausewitzian fashion. Whereas decapitation calls for transformation of the armed forces to make strategic bombing more efficient, denial emphasises better integration of the services in order to achieve more effective destruction from greater range and at higher speed. Simply put, denial stands for exploiting fire-power and movement.[355]

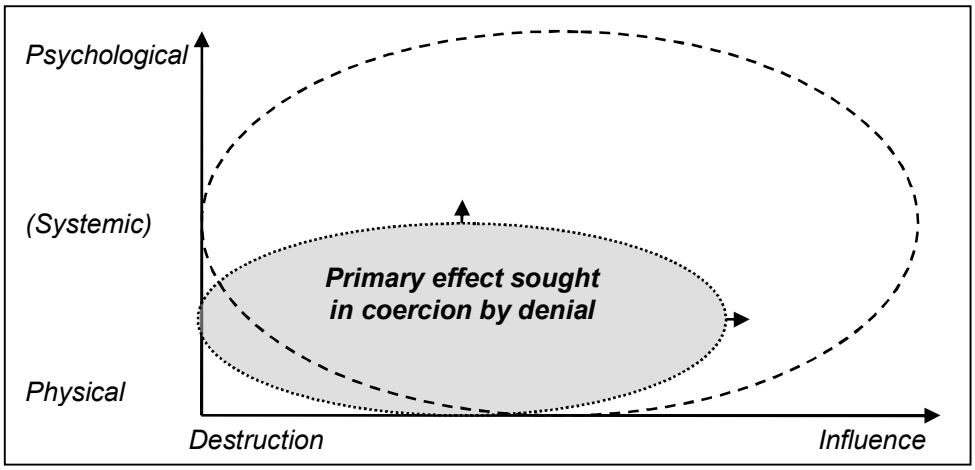

Figure 9 Primary effect sought in coercion by denial

In denial campaigns air operations are an integral part of the entire manoeuvre plan, and make the battlefield the focus of the coercer's efforts. Denial confirms the RAND study mentioned in relation with risk that "in the end only the ground forces [could] transform the Viet Cong from hunters to hunted, defeat them decisively, and establish complete control and security over the population. It follows that the main purpose of air harassment [was] to create favourable conditions for more effective ground offensive operations."[356]

7.5 Air Power and Effects

As the four schools of thought in military coercion have shown, the origins of effects-based operations are rooted in the advent of powered flight. The concept can be traced back to air-power enthusiasts such as Douhet, Mitchell, members of the AACTS and Warden, and to strategic thinkers of a more general kind including Slessor, Liddel Hart, Brodie, Schelling and Pape. It became also clear that many theorists were passionate rather than analytical, and most mechanisms of coercion rested on assumptions advocating quick, clean, mechanical, impersonal and linear solutions. From the earliest days of powered flight theorists have struggled

[355] Pape (2004), p. 129; For this image of war Pape earned much criticism see McPeak, Merrill A.: *A Neater Way to Winn,* Response, Foreign Affairs, September/October 2004, pp. 160-162 and Warden (1997/98), pp. 186-190.

[356] Budiansky, pp. 434-439; Quotation in Goure, p. 20.

"to define and measure the success of operations … in terms of the effect achieved on the enemy".[357]

7.5.1 Similar Mechanism

These strategists embraced the airplane as a formidable and flexible weapon that most cogently reveals the relative effectiveness of various coercive mechanisms. Although in its infancy, the airplane had momentous effects during World War I, its flexibility and versatility impressed many. This significant technological innovation of the early 20th century and its possible application for military purposes resulted in challenging theoretical and doctrinal concepts. Most theorists assumed that precise intelligence is always available; limiting or disturbing factors can always be minimised; concentrating on ends rather than means is a superior alternative to the traditional mechanisms of war; control can substitute for destruction, and strategy can be reduced to targeting issues.[358] Thus we can say that all four schools of military coercion aim at harnessing cause-and-effect relationships in order to achieve desired effects on the enemy. We made it clear that the mechanism for achieving an effect (E) can be understood as a function (f) of an action (a) on an object (o). In a similar fashion Mueller argued that in terms of military coercion the desired change (C) of the enemy can be understood as a function (f) of a given amount of force (f) applied on a certain target (t).[359] This can also be depicted in the form of an equation as follows

$$C = f(f,t)$$

Most theorists regarded the airplane the ultimate weapon, as it was not committed to any one course of action and could switch from one objective to another on short notice. Apart from denial, the basic assumption was that a comprehensive and mostly analytical study can reveal the proper targets, which combined with a well apportioned amount of decisive force, triggers a mechanism that reveals the preferred effect. Due to its inherent mobility and flexibility, the airplane was regarded as a winning factor of the first order possessing the ability to deliver decisive blows. The conviction that this new weapon is superior to the traditional surface-bound services has led many to believe that the airplane is an effective coercive instrument and represents a superior alternative to protracted ground wars. Consequently, most theorists had a firm belief that similar to the British inter-war experience in Mesopotamia, technological advances had reduced war basically to an act of "dealing out punishment in doses precision-calculated to send political signals or keep the [enemy] under control"[360] Hence, technology turned war into an activity that can be controlled in a top-down fashion.

---

[357] MacIsaac, in Paret (ed.), p, 626; Quotation in Peach, Stuart (Air Com.): *Effects-Based Operations: The Contemporary Air Perspective,* Air Power Review, Autumn 2003, p. 27.

[358] Slessor (1954), p. 11; Pape (1996), p. 39; Moran, Daniel: *Strategic Theory and the History of War,* in: Baylis, John/Wirtz, James/Cohen, Eliot/Gray, Colin S. (eds.): *Strategy in the Contemporary World, An Introduction to Strategic Studies,* Oxford University Press, 2002, p. 37.

[359] Mueller (1998), p. 186.

[360] Slessor (1936), pp. 8-9, 70; Quotation in FM 100-20, p. 2; Liddel Hart (1925), p. 54; Douhet, p. 9; Garden, Timothy: *Air Power: Theory and Practice,* in: Baylis, et. al., pp. 138-141; Gilbert, pp. 230-231; Knox/Murray, pp. 179-183; MacIsaac, in Paret (ed.), p. 633.

7.5.2 Similar Elements

Similar to the characteristics of effects-based operations, military coercion theories are based on three common elements. The first element, *effects-focus* is manifest in the idea of achieving effects on the enemy, although depending on the respective schools of thought the effects sought altered from time to time. An examination of the four schools of military coercion made it clear that punishment and risk stood for achieving psychological effects. Whereas decapitation stands for achieving systemic effects on the enemy, denial emphasises the importance of achieving physical effects. The second element, *advanced technology* is defined by the state of available military technology embodied in the airplane and various sorts of bombs that were regarded as significant innovations in any given period. The technology that drove punishment was the airplane carrying various sorts of aerial bombs. Risk was driven by the airplane carrying nuclear bombs. Decapitation is enabled by stealthy airplanes and precision bombs. Denial comes as the result of stealthy and non-stealthy airplanes, dropping mostly precision bombs. The third element, *systems thinking* displayed the biggest diversity of ideas as it largely depended on the individual mind of the respective theorist. In terms of punishment, selected targets such as population and industry indicated a focus away from the battlefield. In a similar fashion, risk focused mostly on targets outside the battlefield such as leadership, and population. However, unlike the exclusive focus of punishment, attacks on the enemy's military were seen as an option. Decapitation rested on systems thinking as targets are grouped around five categories in the form of concentric circles such as the fielded military, population, infrastructure, organic essentials and leadership. Denial has a strong military focus since it stands for targeting military related assets mostly on the battlefield. The basic assumptions of all theories mirror the remarkable trinity of Clausewitz, albeit the emphasis shifted from time to time. The theories reflected the existence of *primordial violence*, the play of *chance and probability*, and *subordination*, which stand for the people, the military and the government. Although it was at the core, military coercion theories rid themselves of the bloody Clausewitzian heritage, no-one could surpass the boundaries he set.[361] Aerial attacks or bombings are the common denominator in all theories. Punishment theorists left the battlefield intentionally in order to find a mechanism that allowed achieving psychological effects directly or indirectly on enemy population. They advocated that through strategic bombing it becomes possible to achieve a popular revolt and coerce the enemy leadership to comply. Risk-oriented coercion was based on the basic tenets of punishment, but as a broader and slower approach it aimed at influencing both population and leadership. Theorists of this school hoped to achieve psychological effects through manipulation of the fear of nuclear escalation. Thus risk also sought to achieve psychological effects mostly outside the battlefield. Decapitation refocused from the psychological domain and emphasised the enemy's physical side. It claimed that a given amount of systemic effects achieved on command and control facilities can result in strategic paralysis that leaves no other option than to comply. It appears that denial closes the gap that began to emerge when early theorists wanted to escape the brutality of the battlefield and the carnage of the trenches. Denial again focuses on the enemy's military capabilities through achieving physical effects mostly against military and military-related targets. Unlike the other theories, the emphasis is again on battlefield attrition and annihilation resulting in physical effects.[362]

---

[361] Clausewitz, p. 101.

[362] Hallman, Wesley P.: *Airpower and Psychological Denial,* Joint Force Quarterly, Issue 37, pp. 33-39.

7.6 Conclusion Part I

The three common elements of effects-based operations indicate that war is seen as a management activity with a clear cut beginning and a definite end. Waging war is understood as the exploitation of technological advantage and the efficient use of scarce resources. Effects-based operations indicate that in the end capital can mostly substitute for personnel. Unfortunately, the Third Wave stands for asymmetric wars in which the enemy has no traditional centres of gravity or resources that can be destroyed by state-of-the-art weaponry. Although in wars the relationship between ends and means might be clear at the strategic level, it may become considerably less clear as specificities emerge and more ambiguous as the full range of military options expands. Wars demand full-time commitment, but offer only prospects for a provisional, modest and always fragile form of control.[363] Thus as long as there is no peer competitor for the West on a global or regional scale, with traditional attributes, it appears that most assumptions of effects-based operations have limited applicability:

- It will be increasingly difficult to link military means with political ends, tactical actions with strategic objectives directly in order to identify, penetrate to and destroy the very centres of gravity within the enemy organisation.
- It will also be inherently difficult to circumvent the slow and painful processes of attrition and annihilation with the aim to achieve quick and decisive victory in the psychological domain aimed at influencing enemy thinking and behaviour.
- It will be increasingly difficult, to save precious resources in terms of time, money and manpower by collapsing enemy's system from the inside-out that exists outside the traditional boundaries of a nation-state.
- In asymmetric wars information superiority and technological sophistication can best be seen as enablers, but not as ultimate leverage. Thus the assumed advantages of effects-based operations can mean no advantage at all.

Apart from the objections that come from the attributes of the Third Wave and the challenges posed by asymmetric warfare, any sober theory of war must take into account that waging war has always been more than linking ends with means in a simple deductive fashion, and in detecting obvious causality on the strategic level in the form of desired or decisive effects. War is fought on a spatial and temporal continuum involving both the material and non-material domains. It is as much a physical as a psychological phenomenon, which spans over many layers. As the limitations of military coercion theories indicate, waging war involves an abundance of physical, systemic and psychological effects. Both punishment and risk put unilateral emphasis on psychological effects. In contrast, decapitation addresses only certain areas of population centres, which harbour leadership facilities. Its basic assumption is that upgraded strategic bombing campaigns based on the application of advanced technologies can crush the enemy's resistance. Strategic paralysis means that the will to resist is not broken, but the systemic effects achieved simply do not allow the enemy to command and control his

---

[363] Dorff, p. 17; Murphy, Timothy G. (Lt. Col.): *A Critique of the Air Campaign,* Aerospace Power Journal, Spring 1994, Internet, accessed 14. 04. 2003, available at www.airpower.au.af.mil/airchronicles/apj/apj94/murphy.html; Hardt/Negri, pp. 37-54; *A Defining Moment in Marine Corps History*, Interview with Gen. Charles C. Krulak, Internet, accessed 15. 08. 2005, available at www.navyleague.org/seapower/ krulak_interview.htm.

functions properly. Decapitation advocates that many systemic effects are sufficiently strong to make the enemy's resistance futile. Parallel attacks assume that the greater the percentage of targets hit in a single blow, the more impossible it becomes for the enemy to respond. Regarding the philosophical foundations there is barely any difference between decapitation, punishment and risk. Denial on the other hand, takes war back to the battlefield. It suggests that careful attrition and annihilation, focusing on physical effects can subsequently generate systemic and psychological consequences sufficient to achieve victory. As one observer pointed out, within the framework of denial the effects that interrupted road and rail traffic in 1991 in Iraq were neither psychological nor temporary, but physical and cumulative in nature.[364] In denial the traditional mechanism of war aimed at attrition and annihilation of the enemy's armed forces is again writ large. The assumed ability of air power to achieve strategic effects motivated military thinkers to search for mechanisms that allow victory without the involvement of irrational costs and losses. In the end, and at least in theory, air power offered a promising solution to protracted surface-oriented attrition and annihilation warfare.[365] Unfortunately, these basic assumptions have never been really validated. Most theorists have felt, rather than known, what air power can and cannot achieve. Regarding the psychological effects of air operations against strategic targets, we can conclude that bombing alone cannot secure war aims, and limitations should be expected regarding its coercive leverage. Victory in war requires multiple pressures such as attacks on deployed enemy forces, destruction of various high-value targets, better co-operation with ground units and better integration of psychological operations with strategic air attacks. Examples from the 20th century showed that enemies capitulated or came to terms only after serious battlefield defeats of their deployed forces. It appears that after a century of the air force's struggle for independence, and claiming the ability to achieve strategic-level effects on its own, only through denial has it become possible that "the balance of forces on the battlefield will progressively shift to the enemy disadvantage as long as the fighting continues."[366] Air-force theories were originally fed by the idea that war can be taken away from the battlefield. However, the airplane only established a new dimension, and fought in it with equal ferocity. Although air power's maturity and independence was regarded for many years as the driving force in military coercion, in the end it was on the battlefield where air power ascended to equality with the other services.[367] Regardless of the age in which mankind lives and the technology it uses, military operations are dirty, up-close and personal experiences that often defy ideas elaborated on the strategic level. Air enthusiasts saw in the air force the service that could control the enemy from the air. Effects achieved by air power have been helpful contributions to success in war, but indicate the impossibility to "control a country from the air, any more than from the business end of a gun."[368] Focusing on enemy psychology was already seen after World War I as a dead end.

---

[364] Warden (1995); Luttwak, p. 196.

[365] Meilinger, Philip S. (Col.): *Air Targeting Strategies: An Overview,* in: Hallion, pp. 51-54.

[366] MacIsaac, in Paret (ed.), 636; Hosmer, Stephen T.: *Psychological Effects of U.S. Air Operations in Four Wars 1941-1991, Lessons for U.S. Commanders,* RAND MR-576-AE, 1996, p. 70-77 (quotation p. 75); Hinen, Anthony L. (Col.): *Kosovo: "The limits of Air Power II",* Air and Space Power Chronicles, Internet, accessed 09. 03. 2005, available at www.airpower.maxwell.af.mil/airchronicles/cc/hinen.html.

[367] Brodie (1955), pp. 4-5; Budiansky, p. 441; Clausewitz, p. 689.

[368] Gordon/Trainor, pp. 473-474; Quotation in Slessor (1956), p. 56.

As the French Marshall Foch bluntly confessed “at the beginning of the war we believed that morale alone counted, which [was] an infantile notion.”[369]

[369] Quotation in Possony, Stefan T./Mantoux, Etienne: *Du Picq and Foch: The French School*, in: Earle, Edward M.: *Makers of Modern Strategy*, Princeton University Press, 1943, p 228.

8 Frictional Mechanism of War

> *"… to discover the situation, such as it is, in spite of its being surrounded by the fog of unknown; then to appreciate soundly what is seen, to guess what is not seen, to take a decision quickly, finally to act with vigour, without hesitation."*
>
> *von Moltke*

8.1 Assumptions and Dynamics

The comparison of the four schools of military coercion made it clear that denial combines traditional mechanisms such as attrition and annihilation with mechanisms aimed at influencing enemy behaviour. It contains elements of both brute force and military coercion. Denial does not suggest that there are quick and cheap solutions in which we can harness causality and focus exclusively on the psychological domain. The application of brute force aimed at unconditional military defeat can never be excluded when waging war. Denial stands for thwarting the enemy's military strategy or undermining his confidence in it.[370] Denial also suggests that the boundary separating brute force and military coercion is more porous than normally expected. In this chapter we expand on denial in order to better understand friction and devote more attention to the mechanism of war in terms of causality.

8.1.1 Towards Battlefield Effects

In general we can say that psychological effects refer mostly to the strategic level, systemic effects address the operational level, and physical effects point towards the tactical level of war. Battlefield reorientation in denial means that we must focus as much on lower-level effects as on higher ones. Victory in denial comes as the result of clashing forces, which indicates that denial and brute force seem to have similar mechanisms. Whereas denial stands for the *possibility* of achieving a given end-state, brute force stands for the *necessity* of achieving an end-state should denial fail. Decisive military victory does not rule out the utility of military coercion. The difference between the two comes from the enemy's particular military strategy. Whereas brute force means large-scale battlefield attrition in order to make the enemy basically defenceless, denial leaves him a certain capacity of military resistance. Although both demand that considerable forces are brought to bear, denial does not aim at fighting to finish. It emphasises a given amount of enemy attrition without attempting to pay the full cost of a military victory. This indicates that military coercion might not always work and there is often no choice, but to defeat the enemy decisively. In fact, successful denial comes as a result of the political ambitions of the belligerents, their chosen military strategy and the domestic politics. An effective denial strategy depends on the strategy of the enemy and requires military pressure to be maintained continuously. Denial can be very expensive and demand more than small fractions of the

[370] Pape (1996), pp. 1, 10-11.

battlefield cost.[371] Achieving various sorts of effects plays a large role in denial since the focus is on military or military-related targets like arms manufacturing facilities, interdiction of supplies to the battlefield, disruption of movement and communication on the battlefield, and attrition of fielded forces. The aim is to weaken battlefield capabilities either directly or indirectly in order to prevent the enemy from achieving his goals on the battlefield. As denial indicates, successful military coercion is hard to achieve and can be attained only if we are prepared to impose demands by force. In other words, military coercion and effects-based operations are not much easier or significantly cheaper than traditional war-fighting aimed at imposing a full military defeat on the enemy.[372] Thus even with a declared cause-and-effect focus we must be prepared for things to go badly and there is always a chance for escalation. Denial indicates that in military coercion the attrition and annihilating enemy military forces must be of first consideration.

8.1.2 Filling the Continuum of War

The introduction of the four schools also made it clear that the more a given school focused on higher order effects, the harder its evaluation becomes:

- Risk, which is the most psychologically oriented and the least focused on compliance by force, appears to be a specific case. The theory was constructed in an age of global confrontation. It worked on a global scale because no nuclear war erupted. However, nuclear weapons could not prevent the eruption of regional wars fought by conventional weapons aimed at attrition and annihilation.
- The most controversial of all schools is punishment aimed at achieving psychological effects directly through conventional weapons. Since the end of World War II military historians have been arguing as to what extent the bombing of Germany and Japan influenced the enemy population's morale and contributed to the victory of 1945.
- Decapitation can be described as an upgraded strategic bombing approach aimed at paralysing enemy systems in the physical domain. Although the enabling technologies are powerful tools, it is still debated to what extent this mechanism works. Bombing critical nodes might have a strong coercive power, but as the 78-day bombing of Serbia in 1999 showed it is not yet clear how bombing alone contributes to stated political goals.

Victory in war is a product of many contributing factors, some of which can be replicated, and some not. Thus the theoretical foundations of risk, punishment and decapitation, together with their suitability to real world challenges deserve close scrutiny.[373] As denial indicates, it is important to address the full continuum of war, and not promoting only one mechanism to the expense of the other. Denial stands for military operations in which the contest is decided by fire support, and the close interaction of fire and manoeuvre in all dimensions. Even if we acknowledge that possessing the technological edge in the form of precision weaponry and stealth are great contributors to success, air power or ground forces alone do not have the

---

[371] Ibid., pp. 12-36; Clausewitz, p. 101.

[372] Pape (1996), pp. 69-79, 314-331.

[373] It is sufficient to think of the great air-power debate that took place in the American defence community and various educational establishments during the 1990s. The debate was initiated by Pape who openly questioned the utility and relevance of strategic bombing.

potential to suffice in the total conflict.[374] Achieving desired effects mostly in the psychological domain and linking political objectives with military actions directly, reflect a vocabulary that has an inherently elegant flair. The tendency of referring to effects especially to psychological ones, is a sort of modern political-military courtship. It is wrapped in a euphemistic vocabulary that might reflect high-level commitment, but often lacks real-world substance. As wars of the 20th century showed, ill-founded, misleading and fallacious assumptions always bore the risk of volatility that resulted in disastrous failures. Attempts to oversimplify military effectiveness, the unrestricted belief in panaceas, an unsophisticated view of war can blur the lines between fact and fiction, and substitute one with the other.[375] We made it clear earlier that in theory, desired effects can be identified and although both objects and actions can be fully known, the mechanism linking causes to effects will always contain a given amount of uncertainty. Effects are complex phenomena that do not allow for decoding all aspects in detail. This problem points towards two different, but interrelated levels:

- The first level refers to the difficulty of identifying a mechanism that explains the interplay of certain actions and objects on the one hand, and the desired effect on the other. None of the mechanisms could deliver a reliable and satisfactory solution to that problem. The closer we move towards physical effects, the easier it becomes to detect causality. However, in terms of psychological effects, it becomes very difficult if not impossible to discern clear causal relationships and we might end up in speculations.[376]
- The second level refers to the problem of identifying a mechanism that translates military effects into political effectiveness. The examples in Vietnam and Afghanistan showed that military victory has often no relevance to the political settlement. Although the West perceives war as an instrument fought for political purposes, current enemies are often driven by motives that regard war an existential phenomenon. Therefore no common basis exists according to which a settlement can be reached, or a better state of peace achieved.

8.2 Exploring the Mechanism of War

In order to better understand the problem of mechanism in terms of causality, we suggest exploring the works of earlier theorists of war. According to the social wave-front analysis, war is an expression of a given society and its conceptualisation always reflects the peculiarities and characteristics of that society.[377] However, contemporary Western military thinking is heavily shaped by two influential classics such as Jomini and Clausewitz. Any thorough examination of war requires that we return to them, as both attempted to examine war's mechanism in detail.

---

[374] Biddle, Stephen: *Afghanistan and the Future of Warfare: Implications for Army and Defense Policy,* Strategies Studies Institute, U.S. Army War College, November 2002, pp. 3-8.

[375] Hammond, Grant T. Dr.: *Myths of the Air War over Serbia, Some "Lessons" Not to Learn,* Aerospace Power Journal, Winter 2000, p. 85; Hammond, Grant T. Dr.: *Myths of the Gulf War, Some "Lessons" Not to Learn,* Airpower Journal, Fall 1998, pp. 16-17; Shy, in Paret, p. 160; Wojtysiak, Martin (Lt. Col.): *Another View of the Myths of the Gulf War,* Aerospace Power Journal, Internet, accessed 17. 09. 2004, available at www.airpower.maxwell.af.mil/airchronicles/apj/apj01/fal01/wojtysiak.htm.

[376] This explains also the difficulty of evaluating success and failure in psychological operations. See Collins, Steven: *Army PSYOP in Bosnia: Capabilities and Constraints*, Parameters, Summer 1999, pp. 57-73.

[377] Toffler/Toffler, pp. 25-42; Jobbagy (November 2005), pp. 13-24.

They applied different methodologies and as a consequence proposed different conceptualisations, which can be seen as the two end-poles of Western military thinking.

8.2.1 Jomini and Clausewitz Revisited

Jomini is often referred to as a narrow and linear theorist of war, who claimed that waging war was science in itself, and advocated that battles can be fought in a scientific manner. However, even he had to acknowledge that many of war's aspects can never be estimated on paper. Thus he felt the necessity to emphasise that an accurate execution of any carefully designed plan was rarely possible and embarrassments had to be expected even in the case of simple questions. The cause for this problem was human nature, as even generals are men who have faults. Conflicting interests, pretensions and rivalries could become important hindering factors in the conduct of operations. As a consequence he spoke of the *real secret of the military genius* and highlighted that in war everything is possible.[378] Like Jomini, Clausewitz also found it difficult to construct a scientific theory of war since it dealt with matters that do not allow for permanent laws. He did not believe in any particular scientific way that helps disarm and defeat the enemy without bloodshed, which he did not regard as a true goal in waging war either. War had its own law and due to the continuous interaction of the forces involved, any attempt to deduce absolute terms would reflect individual imagination and fantasy. The interplay of possibilities and chance made him conclude that guesswork and luck play a great role in war. He also emphasised that absolute mathematical factors can never guide military calculations. War was a human activity that has similarities with a game of cards. Dealing with living creatures never allows for absolute clarity and there is always a margin of uncertainty. For him, war was a complex and changeable phenomenon.[379] Clausewitz emphasised that the enemy's will must be broken as a prerequisite for ending war, but equally advocated the importance of destroying the enemy's fighting forces and the occupation of his country. He also knew that not every war leads to a final settlement and the disarmament of enemy forces is not always needed to achieve peace. He claimed that victory in war does not come from the enemy's outright defeat since destruction can never be an end in itself: it is only a means to an end – a matter of secondary importance. In the case of imparity between the opposing forces he assumed that the weaker side would yield. Nevertheless he regarded war as the realm of uncertainty in which three-quarters of the factors are hidden to various degrees. Chance playes a great role in war since it interferes with the course of events. In order to handle uncertainty he also referred to the military genius and called it the *coup d'oeil*, which was manifested in quick recognition that the mind would normally miss or perceive only after a long delay. No science or analysis, but coup d'oeil makes it possible to overcome fundamental elements of war such as danger, exertion, uncertainty and chance. According to him the single concept of a general friction best expressed the restrictive effects of war, which can turn apparently easy phenomena, difficult. He argued that friction could not be reduced to comprehensible elements and as a consequence it could not be measured.[380]

---

[378] Jomini, pp. 56, 122, 197, 200, 252-257, 274, 300.

[379] Clausewitz, pp. 78-101.

[380] Ibid., pp. 101, 102-114, 115, 138-142.

8.2.2 Human Character and Causality

Clausewitz was aware that the human mind always strives for principles and causal rules in order to settle controversies. However, he also argued that the endless complexities of war allow for considering various principles and systems only in terms of physical phenomena. Attempts to reduce war to a formula containing numbers and functions, was an oversimplification that could not stand up against the realities of war. Even broad arbitrary assumptions often do not correspond with practical experience. Due to war's inherent uncertainty every calculation has to be done with variable quantities. An inquiry aimed solely at physical quantities is absolutely useless since war is always intertwined with psychological forces. Human psyche does not obey rules and can only be described in vague terms. He suggested that for lack of objective knowledge soldiers should trust to their *talent* or *luck*. As he emphasised causality describes the relationship between causes and their effects, and allows for discernible laws. Unfortunately, war as constantly changing and diverse phenomenon does not allow for such laws, since it is composed of actions that have to be handled individually.[381] He warned that things do not turn out in war according to causal expectations as friction always overwhelms the participants with various disturbing and encouraging effects. Friction is such a powerful constituent of war that even surprise, which he thought as the key element of victory, could be held up by its force. He argued that war displays both human strength and weakness and due to the multitude of factors involved no causal concept can be defined with accuracy.[382] A further problem in war is that the limitation of human insight and the occurrence of unforeseeable accidents do not allow for the elaboration and selection of causal options even under favourable circumstances. War displays catastrophes, accidents and missed opportunities, which all indicate that war is more than an act of reason, and reasoning is not war's foremost activity. The means applied are not absolutely necessary or the only ones possible. War is to a great extent, guesswork with numerous possibilities and wrong turns in which great results are often produced by the application of limited means. War has its natural inertia and friction goes together with various human failures such as inconsistency, imprecision and timidity. Friction is an inherent constituent of war and reflects possibilities, probabilities, and luck: all indicate conditions without *logical reasoning*. Due to the multitude of such factors it is difficult to gauge the resistance we face, and there will always be impossible to pair the objectives and the means. *Causality*, *exact sciences* and *mathematical logic* are of little help since waging war is basically an art in the fullest meaning of the term. Due to this vast variety of factors, methodological examinations are rarely possible and the conclusions reached reflect more the intuitive comparison and the qualities of the individual mind. War is shaped by the character of men who take and execute decisions rather than by general and universally applicable causal rules.[383] Both Jomini and Clausewitz can be seen as two end-poles in conceptualising war, but unlike the Swiss theorist, Clausewitz did not attempt to provide the reader with principles and methods. However, he was able to develop enduring ideas and a powerful conceptualisation of war. Although *On War* can be characterised by intellectual flexibility and lack of dogmatism, there is a good reason to believe that most of its content has become obsolete over the years. Clausewitz is a representative of the early 19th century and even if the mechanism of war might remain constant we cannot deny that change is

---

[381] Ibid., pp. 153-171, 175-180.

[382] Ibid., pp. 227, 233, 304.

[383] Ibid., pp. 607-617, 623-626, 692-693, 702-708.

also an important part of it.[384] Thus we propose to focus on war's mechanism manifest in the very concept of friction. Effects-based operations rest on the assumption that it is possible to take advantage of direct causality, which makes possible to link the strategic and tactical levels of war directly. Clausewitz warned that friction denies the presence of traceable cause-and-effect relationships in war and in the case we prove that friction is an enduring phenomenon we can claim that effects-based operations stand for a narrow conceptualisation and have limited practical utility.

8.3 Examining Friction in War

Attempts to question Clausewitz's relevance either partly or entirely are not new as there were such attempts by Jomini. Later on many have also demanded that Clausewitz's image of war should be thrown overboard. Liddel Hart, who was otherwise considered by his admirers as the Clausewitz of the 20th century, was likewise not short of critiques.[385]

8.3.1 Challenging Friction

The way wars are waged changes throughout the ages. War is a social phenomenon and as such, influenced by the peculiar characteristics of the respective wave. The demise of the bipolar world-order made many question the relevance and utility of Clausewitz. There are claims that a different culture of war is emerging and spreading far and wide. The meaning of war changes, and Clausewitz's teachings do not fit present domestic and international circumstances, as manifested in the contradictions between the prevailing military mentality and the occurring exigencies. Thus we should free our mind from the Clausewitzian approach and try to understand this new culture. Undoubtedly, *On War* stretches over 800 pages and it is so broad in scope and so inclusive in methodology, that it can be regarded as a patchwork of loose ideas rather than a well designed and thought-through book. Even Clausewitz himself warned the reader that in the case of an early death, his work would be nothing more than shapeless mass of various ideas and subject to endless misinterpretations. This explains why referring to him is for many both so satisfying and pointless. In fact, five out of his eight books describe the technicalities of wars of his age and reflect the pragmatic observation of a practical military mind.[386] Three books however, contain enduring principles regarding the nature of war in which friction plays a central role. For Clausewitz friction expressed best the true nature of war. It is manifest in inexplicable or random events that jeopardise the relationship between causes and their effects. It is a double-edged sword that both fuels the human desire for causality, and makes its meaning for war irrelevant.[387] The causal focus of effects-based operations indicates a

---

[384] Handel, Michael I.: *Clausewitz and the Age of Technology*, in: Handel, Michael I. (ed.): *Clausewitz and Modern Strategy,* Frank Cass, 1986, pp. 52, 57, 60-61.

[385] Ludendorff, Erich von: *The Nation at War,* Hutchinson, 1938, p. 24; Jomini, pp. 166, 178-179, Liddel Hart (1967), pp. 352-353, 356-357; Alterman, Eric: *The Uses and Abuses of Clausewitz*, Parameters, Summer 1987, pp. 18-32.

[386] Keegan, John: *A History of Warfare,* Pimlico, The Random House Group Limited, 1994 pp. 12-22; Luttwak, Edward N.: *Toward Post-Heroic Warfare,* Foreign Affairs, May, June 1995, pp. 109-122; Clausewitz, p. 78; Fleming, Bruce: *Can Reading Clausewitz Save Us from Future Mistakes?* Parameters, Spring 2004, pp. 62-68.

[387] Clausewitz, p. 406.

direct link between tactical actions and strategic effects. In order to identify controllable actions and the relationship between desired effects the concept focuses more on the outcome of operations than on the way they are conducted. This unilateral emphasis of the ends and neglect of the means explains why Gen. Deptula hopes to subdue the enemy without fighting and destruction. A further reason why friction should deserve close scrutiny is based on the fact that it is the difference between war on paper and real war. The imbalance of ends and means in effects-based operations and the deliberate subordination of the tactical to the strategic level in the form of direct causality, can give the impression that the concept makes it possible if not to eliminate, than at least to reduce friction in war.[388]

8.3.2 Revolution in Frictional Affairs

The claim to be able to *look through* is also supported by the prevailing idea of the Revolution in Military Affairs, which has promised for a long time that advanced technologies can digitalise and make the battlefield transparent. It is not surprising that effects-based operations are often seen as a true revolution of warfare. One important element of effects-based operations is the utilisation of advanced technology, which backs the belief that friction in war can be eliminated by technological means. War is seen as a phenomenon that can be understood and controlled in an analytical top-down fashion. It is perceived as a quick and cheap undertaking, something that can be done efficiently as it is fought for a positive good. Ends/means rationality in war can also result in a direct relationship between military achievements and political goals.[389] In his attempt to examine the relationship between friction and war, Watts re-examined Clausewitz's original concept. He identified a detailed taxonomy composed of seven elements, such as danger, physical exertion, imperfect information, structural resistance, chance events, physical and political limits, unpredictability of interactions, and disconnects between ends and means.[390] Watts concluded that differences in weapons systems similar to that in training and operational concepts can shift the relative balance in terms of friction to one's favour and often in a decisive fashion. However, he equally stated that friction in itself is not a technical problem that can be eliminated. Although technology can contribute to an information-rich environment, man has limitations in absorbing and digesting the information provided. These limitations can be further exacerbated by stress, fatigue and other disturbing factors usually accompanying war. Other limitations in terms of space and time also mean that regardless of technological prowess key pieces of information will always be missed at any given time, in any given place, and by any given person. This mismatch between reality and perception fundamentally limits attempts to predict what cause will result in what effect. We must always expect friction and novelty in war, which indicates that indirect effects in the form of higher order consequences are never

---

[388] Herbig, Katherine L.: *Chance and Uncertainty in On War,* in: Handel (ed.), pp. 104-107; Cimbala, Stephen J.: *Clausewitz and Chaos, Friction and Military Policy,* Praeger Publishers, 2001, pp. 4-13; Handel, in Handel (ed.), p. 82.

[389] Owens, William A.: *Lifting the Fog of War,* Farrar, Straus and Giroux, 2000, pp. 117-149; Knox, MacGregor/Murray, Williamson: *The Dynamics of Military Revolution 1300-2050,* Cambridge University Press, 2001, p. 5: Lazarus, David B.: *Effects-Based Operations and Counterterrorism,* Air & Space Power Journal, Fall 2005, Internet, accessed 14. 10. 2005, available at www.airpower.maxwell.af.mil/airchronicles/apj/apj05/fal05/lazarus.html.

[390] Watts, Barry D.: *Clausewitzian Friction and the Future War,* McNair Paper 68, Institute for National Strategic Studies, National Defence University, 2004, pp. 17, 20-21, 79-86.

predictable with a high degree of certainty. Friction will always dim expectations in terms of detecting causality and achieving higher order effects mostly in the psychological domain.[391] Consequently, friction calls for a more modest way of theorising war. Due to its waxing and waning nature attempts to find a good fit between means and ends, causes and effects mostly fall outside analytic metrics. The frictional nature of mechanisms also indicates that the outcome does not depend on the absolute level of friction experienced, but on a relative frictional advantage. Therefore assumptions that with effects-based operations it becomes possible to reduce or even eliminate friction appear to be mostly baseless and unjustified.[392]

8.3.3 Eternal Phenomenon

The difference we can detect regarding friction of the past and friction today, is that for Clausewitz it was basically created by external causes coming mostly from the enemy's unexpected actions. The growing specialisation and compartmentalisation of Western armed forces, together with self-imposed constraints such as casualty sensitivity and destruction awareness, have resulted that friction today is equally due to internal causes. For Clausewitz friction occurred within war itself, the Third Wave increasingly reveals friction between war and politics. The nature of asymmetric conflicts, the multitude of players and motives involved make extremely difficult to formulate clear and concise ends/means relationships, even at the highest political and military levels. Clausewitz regarded friction as the outcome of different interests within the same culture. However, ad-hoc and multinational coalition operations introduce a heavy load of additional friction. It appears that friction in war had an important past and has a significant role to play in future. The difficult-to-comprehend nature of complex challenges and the ever-increasing dependence on technology indicate that we should expect not less, but more friction to come. Friction is the difference between fiction and reality, expectations and achievements. It indicates that confusion and frustration are inherent elements of war, which will always hinder both the formulation and achievement of desired effects. Friction as an eternal phenomenon will always influence both the means and methods employed and betray expectations and perceptions regarding causes and their likely effects.[393] The taxonomy and the propositions introduced by Watts make us conclude that due to the frictional mechanism of war the outcome is highly contingent, which means that there is only a very low practical ceiling for effects-based operations. We have always to expect indirect effects and other consequences that defy most attempts to develop useful analytical models in order to detect causality:

- Friction indicates that various higher order consequences can arise and stay hidden far after the war ended or remain in the dark forever. War is a social phenomenon dominated by people who have motives, purposes, frailties, and limitations.

---

391 Watts, pp. 79-84.

392 Handel, in Handel (ed.), p. 68.

393 Handel, in: Handel (ed.), pp. 77, 78, 81; Pick, Daniel: *War Machine, The Slaughter in the Modern Age,* Yale University Press, 1993, pp. 32-37; , Pearce, LeRoy J. Dr.: *Coalition Operations in the Global Village,* Internet, accessed 27. 10. 2005, available at www.aiai.ed.ac.uk/project/coalition/ksco/ksco-1999/DOC/pearce-c-ops-global-village.doc; Cimbala pp. 198-209.

- Friction remains a significant part of war and waging it has similarities with gambling in which uncertainty and confusion are not annoyances that can be eliminated gradually, but integral and dominant parts.[394]
- Friction means that waging war is to a great extent based on guesswork and intuition however sophisticated the analytical support might become. Much of Clausewitz and *On War* might go with the wind, but the very concept of friction indicates that there is hardly any difference in terms of mechanism between wars of the past and wars yet to come.

[394] Watts, p. 53; Knox/Murray, pp. 176-179.

9 Scientific Principles, Chaotic Reality

9.1 Science, Causality and War

The very essence of causality can best be described by a series of deductive if/then statements that assume mostly linear connections in which a particular effect results from a particular cause. Clausewitz warned that in war "there is a gap between principles and actual events that cannot always be bridged by a succession of logical deductions."[395] War is composed of a complex web of interconnected constituents in which friction poses a serious challenge. Due to friction, we face circular causation in which causes and effects are connected via feedback loops. There is always a chance of escalation and we have to take into account that tiny differences between causes can lead to completely different effects. This however, indicates the impossibility to predict future time paths in the form of desired effects.[396] In this chapter we examine the problem of unpredictability, incompleteness and instability in war together with the consequences that follow.

9.1.1 War, Science, and the Classics Again

Approaching war in terms of desired effects indicates war to be an analytically solvable phenomenon, which allows for prediction in the form of causal statements. War's frictional mechanism stands for disguised correlations rather than detectable causal chains. Consequently, there is always the risk to disregard the difference that lies between correlation of attributes and causal mechanisms.[397] Addressing the continuum of war in an exclusive way inadequately captures its dynamic nature. Friction explains why it was so difficult for Jomini to establish a scientific theory of war good one and a half centuries ago. Jomini desperately tried to provide his readers with a meaningful set of standardised scientific methods or phenomena. He developed four maxims for the fundamental principle of war, but failed to make that very principle explicit. He provided the reader with eight rules for selecting tactical positions, twelve orders of battle, thirteen points for fighting battles, five directions for an attack by main force, three rules for pursuit, eighteen points for the movements of armies, and nineteen rules for the use of the artillery.[398] However, time has mostly parodied and ridiculed his attempt to provide a scientific categorisation of war. Unlike the appreciation and influence he possessed before World War I, contemporary readers often find his work to be narrow, simplistic, occasionally boring and overtly superficial. His example is a warning that any approach attempting to simplify, reduce and prescribe actions in war is barely more than a dead-end. The analys of only a small number of selected variables has a limited potential that yields a restricted set of options. Putting those

---

[395] Quotation in Clausewitz, p. 125.

[396] Stacey, Ralph D.: *Strategic Management & Organisational Dynamics*, Pitman Publishing, 1996, pp. 177-179; Salmon, Wesley C.: *Causation*, in: Gale, Richard: *Blackwell Guide to Metaphysics,* Blackwell, 2002, pp. 35-42.

[397] Christensen, Clayton M./Raynor, Michael E.: *Why Hard-Nosed Executives Should Care About Management Theory*, Harvard Business Review, September 2003, pp. 67-71.

[398] Kuhn, Thomas S.: *The Structure of Scientific Revolutions,* International Encyclopedia of Unified Science, Foundations of the Unity of Science, Volume 2, Number 2, 1962, pp. 10-13; Jomini, pp. 70-71, 181-184, 188-195, 200-203, 211-213, 242, 254-257, 289-290, 316-319.

options through the filter of various cost/benefit analyses and other probability evaluations further narrows those blinders and does not address important issues such as clarity, rigour and utility for a real-world application. Thus by looking both at Jomini and the common elements of effects-based operations we have the impression that employing analytic principles of natural scientific inquiry can address war fought on paper rather than real war fought with blood and guts. Jomini's rigid, dogmatic and prescriptive thinking has relevance only for the former, and even then with a very strong limitation.[399] Jomini's approach is the best example that forced natural scientific principles based on direct causality and deduction, analytical rationality and categorisation fail to address much of war's frictional mechanism. Although scientific principles might be helpful in describing war, it cannot be analysed on strict scientific principles only. The common elements and characteristics classify effects-based operations as an approach that addresses war mostly in scientific terms. It uses the vocabulary of natural science, which resembles similarities with the failed *geometrical* and *mathematical* schools of European military thinking of the outgoing 18th century. The concept's hierarchy-oriented architectural design bears the danger of taking the art out of warfare by inserting more science at the same time.[400]

9.1.2 Paradigms and Causality

In order to explain the recurring popularity of applying scientific principles to war we suggest to take a close look at natural science and the way it develops. According to Kuhn, the early stages of any natural science for which he used the term *normal science*, display a vast array of descriptions and interpretations that largely disappear when one of the competing schools triumphs. Natural scientific inquiry is a causal process that works towards homogenisation and ends with the acceptance of a certain paradigm. It proceeds by improving paradigms in the form of an infinite and spiralling determining-matching-articulating cycle. In the first stage it determines significant facts of reality at hand, then it matches significant facts with theory, and in the last stage it articulates the theory based on significant facts. This process implies that paradigms are objects for further articulation and specifications should new conditions arise. They are built on a few problems at hand to be solved and their success depends largely on the ability to force those problems into a preformed and inflexible box. Paradigms do not call for new sorts of phenomena since those that do not fit into them are often ignored and normally left aside. The result of this causal approach is a drastically restricted and narrow focus, which is both the driving force behind any natural scientific inquiry and the enabler to predict factual information of intrinsic and substantial value.[401] Paradigms indicate that natural scientific endeavour is highly cumulative in its results. The steady extension of its scope and the ever-increasing precision of the knowledge gained result that natural science does not aim at factual or theoretical novelties, and in the case of success it finds none. As time passes not all existing theories of a natural scientific field support a given paradigm. Paradigms do change and those changes are normally accompanied by many speculative, roughly articulated and ad-hoc modifications. Although paradigms can tolerate crises and accommodate tensions to a certain degree, due to their causal focus scientists normally try to avoid anomalies and conflicts with

---

[399] Shy, John: *Jomini*, in Handel, pp. 164-184.

[400] Vego, Milan N.: *Effects-Based Operations: A Critique*, Joint Force Quarterly, Issue 41, 2nd Quarter 2006, pp. 51, 54.

[401] Kuhn, pp. 17-34.

existing paradigms. Consequently, natural science proceeds through the change of paradigms, which explains why a scientist does not see something as something else: he or she just simply sees it. As a result of the causal focus of paradigms natural science proceeds towards a narrowing and ever increasing subdivision of its field of inquiry. It is this causal focus, which separates natural scientific from artistic activities. Clausewitz indicated that natural scientific endeavour with all its paradigms, methods and standards seeking causality, does not have much relevance for war. In other words, friction does not allow for a narrow focus aimed at exploiting cause-and-effect relationships.[402] However, even the causal focus of natural science does not indicate that paradigms can stay unchanged. They do change from time to time, which induces re-examination and re-education of the existing world view. This painful and controversial process is normally accompanied by the emergence of a novel *gestalt*. A gestalt refers to functional units, which have properties that cannot be derived from the parts as a result of simple summation. In other words, gestalts indicate that causal constructs are always imperfect.[403]

9.1.3 Science as Convenient Language

The most striking character of natural science is its ever-increasing specialisation, which evolves through the prolonged utilization of the scientific method of inquiry. In terms of scope and concern, the successive stages point towards an increase in detail and refinement proving that while natural science can grow in depth, it may not grow equally in breadth. Although facts of natural scientific inquiry reflect the crude facts of nature, they translate these facts into another and more convenient language. Thus the properties of the raw material on which the inquiry focuses always limit scientific freedom. This limitation in terms of causality indicates that the border between rough and scientific facts can never be precisely drawn.[404] Due to such imprecise borders, any given law of natural science is always approximate, probable, and incomplete. Although it can be replaced by other, closer and more probable laws ad infinitum, it will always be an approximation, differing as little as chosen "from exactitude and the probability from certitude."[405] Laws and paradigms are useful tools for natural scientific inquiry, but they are by definition imperfect and provisional. The often praised objectivity of natural science is nothing more than a provisional, crumbling and crude image, which indicates that even natural science can never be true, only convenient.[406] Approaches based on causality have limited practical utility and indicate analytical convenience rather than real-world relevance.

9.1.4 Gestalt and Causality

We made it clear that Clausewitz did not attempt to provide a scientific image of war. He did not come up with any paradigm for a phenomenon that "appear[s] to defy a "scientific" approach."[407] Clausewitz regarded war an integrated and holistic activity in which nothing could constitute a functional unit. His metaphysical mode, reflecting methodology and scientific vocabulary further

---

[402] Ibid., pp. 35, 43-46, 52-61, 78-79, 85, 92-109; Clausewitz, pp. 155-162

[403] Kuhn, pp. 111-115, 139, 146-161; Gove, p. 952.

[404] Ibid., pp. 170-174; Poincaré, Henry: *The Foundations of Science, Science and Hypothesis, The Value of Science, Science and Method*, University Press of America, 1982, pp. 330-333.

[405] Quotation in Poincaré, p 341.

[406] Ibid., pp. 340-355.

[407] Klinger, Janeen: *The Social Science of Carl von Clausewitz,* Parameters, Spring 2006, pp. 79, 88.

indicate that he did not search for causal explanations. However, there is one common denominator that forms a recurrent pattern in his work. *Unpredictability* as gestalt manifested in friction, best expresses his most important message: war is an extended event that cannot be properly described as the exact sum of smaller and independent events. Unpredictability revels war as a human phenomenon, which poses problems that often fall outside the reach of natural scientific inquiry based on paradigms and causal explanations. Unpredictability helps us see war as a functional whole that cannot be compounded from the action of its constituent parts. Unpredictability can be described with a certain precision, but this precision is not necessarily relevant to the parts. War does not allow for logical, direct and traceable connections between causes and effects. Unpredictability comes as a result of mutually determined parts, which indicate an interactive process that cannot be adequately described by the sum of causal relationships. War's frictional mechanism indicates that causes and effects are often the result of intrinsic interactions.[408] In war unpredictability comes as a result of terror, disequilibrium, and non-linearity created by two opposing groups of intelligent human beings. We learned that paradigms stand for firm and reliable information regarding some basic assumptions in terms of causality. Unpredictability in contrast, acknowledges that war always depends on a wide variety of factors that can either be known, or unknown, but can become knowable, or factors that are unknown and remain potentially unknowable. In sum, unpredictability is responsible for the gap between information known and information desired to be known, which can allegedly be eliminated if we adopt effects-based operations.[409]

9.2 Unpredictability and Consequences

Natural science and its supporting paradigms always assume that there are clear and definite answers to clear and definite questions. The driving force is a causal assumption that information known and information desired can eventually overlap. However, in the case of war we must assume that there is no such overlap. The only certainty regarding wars is that the war actually fought differs from the war one expected to fight. As Clausewitz pointed out, war often seems to be the difference between plans and events, fiction and reality. The most striking difference between war and natural science is that the research of the former can mostly be defined by a lack of any significant progress. This also explains why it is still possible to refer to a theorist who lived nearly two centuries ago. The many theories of war display various mutually inconsistent propositions and findings, which exist side-by-side and do not allow for the emergence of any paradigm. This anomaly is mostly of a systemic nature, and due to the impossibility of applying the methods of natural scientific inquiry. War is a context-dependent

---

[408] Asch, Solomon E.: *Gestalt Theory,* in Sills, David l. (ed.): *International Encyclopedia of the Social Sciences*, Volume 16, New York Macmillan & The Free Press, 1972, pp. 158-174.

[409] Gove, pp. 952, 1421; Mansfield, Sue: *The Gestalts of War, An Inquiry into Its Origins and Meanings as a Social Institution,* The Dial Press, 1982, pp. 232-240; McCrabb, Maris Dr.: *Uncertainty, Expeditionary Air Force and Effects-Based Operations,* Air Force Research Laboratory, 2002b, pp. 7-8, Internet, accessed 23. 04. 2003, available at www.eps.gov/EPSdata/USAF/Synopses/1142/Reference-Number-PRDA-00-06-IKFPA/ uncertaintyandoperationalart.doc.

cultural and social system, which consists of a network of components often acting in parallel. The result is that everything moves, as nothing in war is stationary.[410]

9.2.1 Unpredictability and Non-linearity

Unpredictability as proposed gestalt might be bewildering at first. During our life we are socialised for seeing the known, and are rarely prepared to learn about the unknown. Consequently, the known is pressed on our mind from the outset and the unknown is regarded mostly as irrelevant. We conveniently move along a narrow path of knowledge and think that more is known than actually is. As time passes we are confident that many unknown things usually become known. However, in the case of war as friction indicates, beyond the contours of the unknown there is a vast array of inherently unknowable phenomena. Natural science reflects the natural world by focusing on the known and the unknown, but mostly leaves the unknowable out of its scope. It is a correct, but artificial reflection of the natural world in which paradigms provide convenient tools that are always simpler and more controllable than the natural and original. As various natural and man-made industrial disasters have shown, even the simple and the artificial can slide out of hand. Given that war is waged by complex and idiosyncratic humans, any attempt to separate the known, the unknown and the unknowable become impossible.[411] Consequently, if we had a better understanding of the known, the unknown, and the unknowable, we could gain a broader perspective for dealing with a complex human phenomenon such as war. This however, requires that similar to friction, we must thoroughly elaborate on the attributes of unpredictability.

9.2.2 Sources of Unpredictability in War

Earlier we explained that identifying a useful mechanism for achieving an effect is the Achilles heel of effects-based operations. In terms of causality we face various possibilities in war, which we can identify as known and obvious, unknown, but knowable, and inherently unknowable. Thus the real significance of unpredictability lies exactly in the area in which the known, unknown and unknowable meet. Clausewitz himself emphasised the impossibility of making predictions regarding the outcome in terms of causal statements. It is not surprising that for critiques *On War* is a theoretical mess, since it offers many and often contradicting views regarding the mechanism of war. Although Clausewitz's reasoning was limited by the respective state of science and its vocabulary, as a compelling classic of Western military thinking, he was among the first who explicitly addressed war's complex and non-linear character. He emphasised that the conduct of war is not an analytical process, but one that always changes in an unpredictable way. Confronted with the unknowable and having no better toolset than the scientific vocabulary of the early 19th century, explains why he introduced the idea of friction,

---

[410] Friedman, George: *The Unpredictability of War and Force Structure,* The STRATFOR Weekly, 29 September 2003, Internet, accessed 12. 08. 2005, available at www.vialardi.org/IRAQ/unpredictability_of_war.html; Geeraerts, Gustaaf: *Non-Linearity, Chaos and the Predictability of War,* Pole Paper, Volume 4, Number 1, January 1998, Internet, accessed 02. 08. 2005, available at www.poli.vub.ac.be/publi/pole-papers/pole0401.htm.

[411] Gomory, Ralph E.: *The Known, the Unknown and the Unknowable,* Essay, Scientific American, June 1995, p. 88.

which is an essentially mechanical, hence a natural scientific term.[412] Clausewitz perceived war as a phenomenon involving a large band-with of interactive and competing factors that display a messy interplay between order and disorder, predictability and unpredictability. For him, waging war was a non-linear and dynamic process in which the inherent complexities and probabilities could not be seen as isolated phenomena. Although the unpredictability of war is manifest in nearly every book of *On War*, Beyerchen identified three sources as follows:

- *Interaction* – unpredictability of interaction emphasises war as an interactive process between intelligent and adaptable human beings. Actions in war do not produce simple reactions, but dynamic interactions, and any attempt to anticipate the enemy's move runs into considerable difficulty. Interactions allow only for vague assumptions in the form of generalisations based on qualitative theorising. War is a structurally unstable phenomenon, which means that participants must always expect disproportional effects and unpredictable situations.
- *Friction* – this source of unpredictability has already been detailed. It is the sort of resistance that stands for the feedback effects responsible for constant novelty, and the fact that things in war never go as planned. Friction is *the* noise in the system of war and expresses how information distortion and overload can produce uncertainty regarding the actual state of affairs. Both resistance and noise emphasise that it is not possible to calculate in advance what cause results in what effect. It is equally impossible to predict which effect will turn out to be critical and decisive.
- *Chance* – unpredictability from chance means that most of the factors on which actions are based are obscured and distorted in war. Chance has three sources from which it stems, such as statistically random phenomena, amplification of micro-causes, and the result of analytical blinders. All refer to the role of probability in calculations due to the enormous amount of variables. The result is that small causes can generate disproportionate effects, which indicates that there will always be the possibility that the result of any given action can defy the odds. Chance mirrors the idea that the precision of available information regarding causes and their effects is always limited and "attempts to reconstruct cause and effect [will] always face the lack of precise information."[413]

Clausewitz emphasised that human intuition is guided by linear conceptions, which are of analytical convenience rather than real-world relevance. Unfortunately, as unpredictability indicates, attempts to generate principles for the conduct of war and discern clear causality is a desirable, but an unattainable goal.[414]

9.2.3 Chaos and Determinism

War is a phenomenon composed of a multitude of connected parts. According to Clausewitz every act in war has consequences, which could be either intended and immediately obvious, or unintended and delayed. Although he knew that war displays cause-and-effect relationships, he

---

[412] Beyerchen, Alan D.: *Clausewitz, Nonlinearity and the Unpredictability of War,* Internet, accessed 02. 08. 2005, available at www.clausewitz.com/CWZHOME/Beyerchen/CWZandNonlinearity.htm; Fleming, p. 69.

[413] Beyerchen (quotation ibid.).

[414] In ibid.

equally argued that war's frictional mechanism renders it largely impossible for most attempts to take full advantage of direct causality.[415] Whereas he invented friction to describe war's unpredictability, we can refer to the recent concept of *chaos*, which offers a more detailed insight into the mechanism of war. Strictly speaking chaos is a mathematical concept that does not mean anarchy or confusion. It simply describes the disorder that arises from non-random causes. Chaos is used to describe a range of irregular behaviours in which seemingly random occurrences can be depicted by entirely deterministic and often very simple equations. Chaos occurs in nearly all aspects of military affairs and stems from the presence of feedback. In general we can say that the behaviour of a chaotic system is non-periodic and apparently random, which means that the system's response is recurrent, but no longer predictable. Thus the inability to make long-term predictions in chaotic systems is not due to the lack of data, but an immediate consequence of the non-linear rules that govern its behaviour. Deterministic chaos can best be described as irregular or random appearances of nonlinear dynamic systems, in which dynamical laws determine the time evolution of the system based on its history. The necessary ingredients for a system to be labelled as chaotic, are, among others, boundedness, non-linearity, non-periodicity, sensitivity to initial conditions, and mixing. Chaos' biggest implication for war is that in non-linear systems we must always expect instability in the form of novelty.[416] Clausewitz suggested war is chaotic, which breaks down predictability. The result being that there is no way to predict the effect of the actions of the participants with any great certainty. Historical evidence indicates that predictability and control are already lost at the threshold separating war and peace. Chaos indicates that small perturbations of initial conditions can lead to unforeseen changes, since war's unpredictability is as much manifest in creating structures, as it is in tearing them apart. In war the creation and dissolution of order go hand in hand and defy most explanations based on deductive causal models, which were identified as an important characteristic of effects-based operations.[417]

9.2.4 War and Determinism

Although chaos is a deterministic mathematical concept that does not mean randomness, in English parlance it is understood heuristically, and synonymous with chasm, gulf or abyss. Thus chaos refers to chance, which is subject to no law and displays no signs of uniformity. It is not a distinct or an orderly form, but precedes the creation of order. In war military operations often display a state of confusion including complete disorder, lack of sequence, organization, and any sign of predictability. Chaos in war seems to be for many "a confused mass or agglomerate of matters or heterogeneous items that are hard to distinguish, isolate or interpret."[418] The question

---

[415] In ibid., pp. 145-152.

[416] James, Glenn E.: *Chaos Theory, The Essentials for Military Applications,* The Newport Papers, Naval War College, October 1996, pp. 2-6, 14, 27-28, 38, 46, 53; Durham, Susan E. (Maj.): *Chaos Theory for the Practical Military Mind,* Air Command and Staff College, March 1997, pp. 1-2, 6-15; Ilachinski, Andrew: *Land Warfare and Complexity, Part I: Mathematical Background and Technical Sourcebook,* Center for Naval Analyses, CIM 461, July 1996a, p. 27.

[417] Beyerchen; Saperstein, Alvin M.: *Chaos – a model for the outbreak of war,* Nature, 24 May 1984, pp. 303-304; Saperstein, Alvin M.: *War and Chaos,* American Scientist, November-December 1995, p. 548; Kuruc, Anton: *The Relevance of Chaos Theory to Operations,* Australian Defence Force Journal, Number 162, September/October 2003, pp. 4-6.

[418] Quotation in Gove, p. 375.

regarding war, chaos and determinism arises naturally: is the chaos found in war deterministic or heuristic? We made it clear that natural scientific inquiry can best be characterised by attributes such as covering laws, known initial conditions, deduction, prediction and explanations. The results are deductive-nomological models capable of connecting causes and their effects, each occurring as contiguous instants at their own place and time. Mathematically chaotic systems are deterministic and governed by laws that indicate intimacy between causes and their effects, since only their sensitivity to initial conditions qualifies them as chaotic. In war however, attempts to connect causes and effects run against war's frictional mechanism lacking such intimacy. The multitude of factors, motives and players involved distorts any accurate statement regarding initial conditions. Despite similarities in terms of chaos, war probably cannot be regarded as a chaotic system in strictly mathematical terms. Although it displays particular factors and events coalescing in various proportions to realise their end, war is far more complex than any sophisticated mathematical model. The scope and complexity of the factors involved, together with the human tendency to gauge decisions by relatively external events indicate the impossibility of comprehending all variables. The result is that war cannot be regarded as a closed and isolated phenomenon. The greater the temporal and spatial difference between initial conditions, the bigger the inaccuracy with which those conditions can become known. Temporal and spatial factors always diminish the accuracy of any deductive and nomological explanation, which in terms of war can only cover events and their immediate consequences. This is the very reason for why it is relatively simple to discern causality in the case of physical effects, and nearly impossible in the case of psychological effects. War displays tangled and intricate relationships in terms of causality. As various temporal and spatial limitations indicate, in war causal relationships are never fully contiguous or fully point-like.[419] Consequently, any attempt to detect causality must contend with an emergent novelty. Earlier we made it clear that war does not allow for any separation into parts to be studied individually. It is composed of so many components and elements that identifying causal subordinations to newly emerging processes can be very difficult, if not impossible. Although certain aspects of emergent properties might allow for detecting causal relationships, other aspects possess characteristics of their own that cannot be determined in terms of causality. Thus even in the case of a systemic approach based on analytical rationality and categorisation, we face a general methodological problem. Any attempt to identify the components of a given system and the dimensions according to which they are arranged can only be done incompletely. Open and dynamic systems such as war evolve over time, and any identification process can be considered adequate only, if we are able to enumerate all the unfilled positions and the strains they create. This however, is again supplicated to a novelty we cannot anticipate as such systems do not exhibit mathematically representable temporal series of behaviour. Consequently, the system is unquantifiable in terms of causal relationships and does not permit accurate prediction regarding its future states.[420]

---

[419] Reisch, George A.: *Chaos, History and Narrative,* History and Theory, Winter 1991, pp. 1-20; Pool, Robert: *Chaos Theory: How Big an Advance?* Science, 7 July 1989, pp. 26-27.

[420] Emery, Frederick E.: *Methodological Premises of Social Forecasting,* in: Annals of the American Academy of Political and Social Science, Volume 412, The Information Revolution, March 1974, pp. 97-105.

9.2.5 War as Natural Form

The issue of determinism/indeterminism is closely related to human free will and means that an irregularity as understood heuristically, is not generally incompatible with determinism, except when it has no determining conditions for its occurrence.[421] We often might not precisely know the conditions for the occurrence of many chaotic events, but are basically confident regarding those conditions. This confidence explains why it is possible to establish relationships between statistical properties of events, and why we are less successful in doing the same for individual events and their properties. Applying various statistical variables expresses our ability to consider the statistical properties of the elements accompanying the events. Therefore, the question of whether events occur in an absolutely heuristic or deterministic fashion is not an issue that has significant importance, since real life is compatible with both alternatives. Thus the question of whether structures are heuristic or deterministic in war is basically nothing more than a subject of inconclusive controversy, since both indicate unpredictability. Heuristic and deterministic structures refer to natural forms, which stand for occurrences and phenomena we can perceive. They are isomorphic structures across the fields of human inquiry such as biological cells, economic societies, the population of organisms, and in our case – war. Natural forms can be understood either as a *natural complex* or a *natural system*. Although both refer to the same, they possess different attributes. Whereas a natural complex displays purposeful forms and organic interactions among the constituents, a natural system displays chaotic forms and topographic interactions among the components.[422] Thus any given natural form can be examined either as a natural complex or as a natural system. Although both constructs stand for unpredictability, the difference comes from subjective interest:

- *Natural complex* – is a form composed of constituents, which are non-separable from each other. Every attempt to divide or dissect a natural complex obviously changes its identity. Due to the organised division of labour within such a complex, one constituent's particular function complements the function of the other constituents organically. The unpredictability of a natural complex arises from non-determinism, as it reacts differently to the same stimulus.
- *Natural sys*tem – is composed of constituents that are separate, but not independent from each other, which indicates that the components act as external and arbitrary impetuses. They are separate, but have a chain-like integrity that cannot be divided. Consequently, unpredictability of a natural system is the result of human ignorance regarding all the factors at play and we face determinism in which topographic interactions involve efficient causation.[423]

War as a natural form can be regarded both as a heuristic and deterministic phenomenon in which the difference does not come as a result of the underlying attributes, but as the respective inquiry. War as a natural form indicates similarities with systems, such as the weather or rain

---

[421] Lorenz, Edward N.: *The Essence of Chaos*, UCL Press, 1993, pp. 157-160.

[422] Nagel, Ernest: *The Structure of Science, Problems in the Logic of Scientific Explanation,* Hackett Publishing Company, 1979, pp. 317-335; Khalil, Elias L.: *Natural Complex vs. Natural System,* Journal of Social and Biological Structures, Volume 13, Number 1, 1990, pp. 11-20.

[423] Khalil, pp. 21-31; Buchler, Justus: *Metaphysics of Natural Complexes*, Columbia University Press, 1966, pp. 1-51.

forest, which might be heuristic real-world phenomena, but can nevertheless be modelled and explained to a given degree by deterministically chaotic mathematical models.

9.3 Incompleteness and Instability in War

Due to the presence of chaos in war the history of warfare is replete with examples in which dramatic consequences resulted from minor actions, or that identical actions, depending on the context, have resulted in different outcomes. War as a distinct and specific form of social interaction does not always display a direct relationship between causes and effects. Human interactions are context dependent in which similar causes can lead to very dissimilar effects. Nevertheless, the obvious similarity between chaotic abstract mathematical models and chaotic social and cultural phenomena such as war, allow for an extended examination of friction and unpredictability. Both depend on factors that can drive the system from stability to turbulence and back again. Prediction becomes impossible since chaotic structures are vulnerable to dissolution, and the higher the number of actors and longer the time-scale of prediction, the greater the problem of accuracy. Regardless of whether chaos is seen as a deterministic or heuristic phenomenon, it indicates that in war the general push for stability is nothing more than illusion.[424]

9.3.1 War and Incompleteness

War is full of dispersed, diffuse, intermittent and irregular processes, which stand for fluid and dysphasic movements that constantly erode attempts to achieve symmetry and order. Consequently, war stands for a constant interplay between fractalisation and the drive for homogeneity.[425] War as a natural form also reminds us that any outcome reflects the complex interactions of the constituents in which unpredictability best catches the "combined effect of friction, disruption, and lethality of unit behavior".[426] Regardless of how we name the aggregate results, war does not provide for consistency and completeness. Whereas consistency refers to the lack of contradictions, completeness expresses the ability to provide for proofs of all true statements. Even if war provided for such attributes and could be described entirely in mathematical formulas, Gödel proved that it is not possible to reach consistency and completeness. According to him all formal mathematical systems, despite the fact that they display completeness and consistency, are inherently incomplete. They might be true, but cannot be proved despite the abundance of existing axioms and rules of inference. Gödel

---

[424] Mann, Steven R.: *Chaos Theory and Strategic Thought,* Parameters, Autumn 1992, pp. 54-68; Peatland, Pat A. (Lt. Col.): *Center of Gravity Analysis and Chaos Theory,* Air War College, Air University, April 1993, pp. 10-11.

[425] Saperstein (1995), pp. 548-557; Beaumont, pp. 3-12; Nicholls, David (Maj.)/Tagarev, Todor (Maj.): *What Does Chaos Theory Mean for Warfare?*, Aerospace Power Journal, Fall 1994, Internet, accessed 10. 12. 2003, available at www.airpower.maxwell.af.mil/airchronicles/apj/apj94/nichols.html; Weeks, Michael R. (Maj.): *Chaos, Complexity and Conflict,* Air & Space Power Chronicles, Internet, accessed 22. 05. 2003, available at www.airpower.maxwell.af.mil/airchronicles/cc/Weeks.html.

[426] Cramer, Friedrich: *Chaos and Order, The Complex Structure of Living Systems,* VCH Verlagsgesellschaft, 1993, pp. 115-117; Pfaff, Charles A. (Maj.): *Chaos, Complexity and the Battlefield,* Military Review, July August 2000, pp. 83-86; Herman, Mark: *Entropy-Based Warfare: Modeling the Revolution in Military Affairs,* Joint Forces Quarterly, Autumn/Winter 1998-99, pp. 85-90 (quotation p. 87).

understood formalisation as consistency and completeness, in which axioms and rules are tools applicable to all mathematical questions in expressible formulas. Consistency and completeness can never be reached even in formal mathematical systems, as there would always be simple problems that cannot be decided from axioms. Since problems of this kind appear in a very extensive class of formally expressible systems, he concluded that every formal system must contain propositions that cannot be decided. In other words, there would always be propositions that cannot be proved or disproved. Thus Gödel's theorem indicates that there are always propositions that assert their own improvability. Consequently, even formal systems in which the class of axioms and rules of inference can be recursively defined display undecidable propositions. Similar to a complex social phenomenon such as war formal mathematical systems are incomplete and display logical inconsistency.[427] Although his theorem refers to formal statements of mathematical truth, it also sheds light indirectly on problems found in the cause-and-effect relationships during war. Among others, his incompleteness theorem explains why computer-based simulations of war are essentially unstable and display inconsistency between input and output. Computer simulations are excellent examples that even if there are definable deterministic relationships within a given system that can be formalised mathematically, we must always expect occurrences that cannot be proved or disproved in terms of causality.[428]

9.3.2 Structural Variance and Non-Monotonicity

Despite attempts to comprehend war in terms of causality we always face inconsistency and incompleteness as even simpler settings that attempt to model it, show non-linear attributes and signs of instability. The Lanchester equations were the first *combat model* that attempted to estimate war mathematically in terms of casualty rates. Lanchester wanted to catch the essence of loss ratios in combat based on a pair of coupled differentials. From a contemporary point of view the equations seem to be very crude and clumsy tools. Growing computing power in the second half of the 20th century has enabled analysts to model increasingly more aspects of war's complex features. However, this development has shown that the relatively simple model instability of the Lanchester equation has been replaced by others, yielding more divergent and unexpected results.[429] The term *structural variance* was the first attempt to express the occasional and seemingly erratic behaviour that came from a strictly deterministic mechanism of the models employed. Another attempt to describe model outputs, which were seen as irregular functions of some input parameters, resulted in the term *non-monotonicity*. Both terms describe erratic outputs that were regarded mostly as the analysts' faults. Although first efforts were aimed at finding reduction techniques for these anomalies, later it was found that in the case of complex simulations, even infinitely small factors such as computer rounding errors can become the source of instability. It was concluded that dynamic instability appears to be an inherent

---

[427] Gödel, Kurt: *On Formally Undecidable Propositions of Principia Mathematica and Related Systems*, Basic Books, 1962, pp. 37-41, 62, 69-72; Coveney, Peter/Highfield, Roger: *Frontiers of Complexity, The Search for Order in a Chaotic World*, faber and faber, 1995, pp. 25-28.

[428] Gove, pp. 153, 1635, 1819.

[429] Sidran, Ezra D.: *A Calculated Strategy: Readings directed towards the creation of a strategic artificial intelligence,* Readings for Research, Spring 2004, pp. 11-13, Internet, accessed 10. 11. 2005, available at www.cs.uiowa.edu/~dsidran/ReadingsForResearch2.pdf; Speight L. R.: *Lanchester's Equation And The Structure of the Operational Campaign: Between-Campaign Effects,* Military Operations Research, Volume 7, Number 2, 2002, pp. 16-21; Glenn, p. 75.

feature of complex simulations. This conclusion however, allows for a much broader generalisation. If deterministic combat models based on highly controlled conditions can display irregular outputs, than real wars in which the signs of determinism are less clear may be destined to do so. Real war is always more complex than any model can ever become; therefore if relatively simple computer models can show signs of instability then "the instability of the corresponding reality is certainly implied."[430] This, however, indicates that similar to the concept of friction, chaos allows only for a rather low practical ceiling for effects-based operations.

[430] Speight, L. R.: *'Structural Variance' or 'Non-Monotonicity' Effects in Combat Models: A Review,* Military Operations Research, Volume 8, Number 1, 2003, pp. 18-19; Saperstein, Alvin M.: *The "Long Peace" – Result of a Bipolar Competitive World,* Journal of Conflict Resolution, Volume 35, Number 1, March 1991, pp. 70-72; Ilachinski (July 1996a), pp. 125-127; Ilachinski, Andrew: *Land Warfare and Complexity, Part II: An Assessment of the Applicability of Nonlinear Dynamics and Complex Systems Theory to the Study of Land Warfare (U)*, Center for Naval Analyses, CRM 96-68, July 1996b, pp. 62-64.

10 Attributes of Causality

10.1 Dissecting the Continuum of War

In order to better understand the mechanism of war, in this chapter we suggest examining it along two properties such as *couplings* and *interactions*. Although the properties we use are of a qualitative nature and were originally introduced to understand and study the way accidents happen, in a slightly modified form they equally explain the way unpredictability develops. The proposed structural analysis displays unpredictability as a phenomenon that comes mostly in the form of unintended and unexpected effects. [431]

10.1.1 Combination of Properties

Although war happens on a continuum, the proposed properties allow for dissecting it into four rough areas representing different sorts of relationships. This way we can address the so-called intricate relationship between causes and effects. As depicted in Figure 10 whereas interaction can either be *linear* or *complex*, coupling may be *tight* or *loose*.

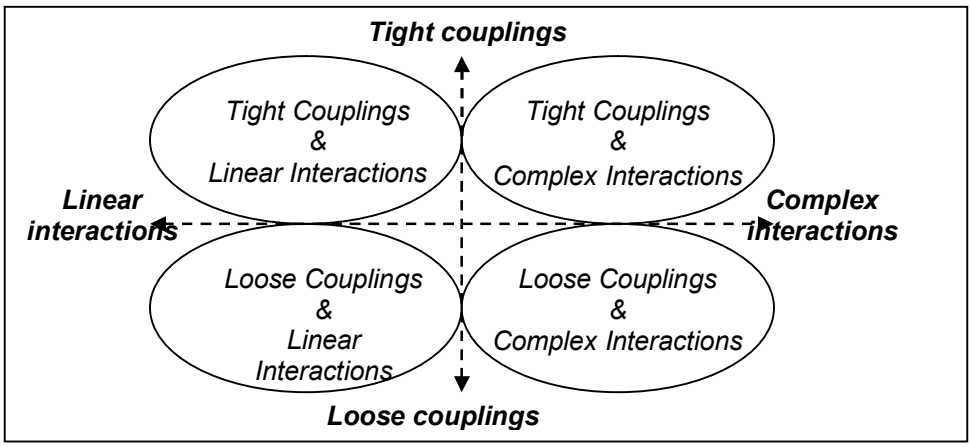

Figure 10: Perrow's quadrant

Interactions will be the first property explored. Due to their simplicity and comprehensibility, linear interactions allow for visible and simple relationships between causes and effects. Linearity can be anticipated since the underlying sequence of causality is directly comprehensible. Complex interactions indicate branching paths, feedback loops and jumps from one sequence to another. Here connections multiply in unexpected ways often revealing unintended and unfamiliar effects. Causal relationships are outside the normal and assumed sequence of events and are either invisible or not immediately comprehensible.[432] Linear interactions can also display invisible cause-and-effect strains, but they occur mostly in a well-defined segment and sequence. Complex interactions do not stand for a well-defined segment or

[431] Perrow, Charles: *Normal Accidents, Living with High-Risk Technologies,* Basic Books, 1984, p. 63.

[432] Ibid., pp. 75-78.

sequence, as causes and effects are linked differently and may interact in unexpected ways. Causal processes are more indirect and inferential so that not even the tip of an iceberg is visible. Complex interactions are full of misunderstood or missed signals and faulty information regarding causes and their likely effects. Whereas linear interactions have minimal feedback-loops and are generally clear and concise, complex interactions are more likely to display unanticipated or unintended relationships. The second property is coupling, which refers to slack or buffer in cause-and-effect relationships. Tight couplings do not contain slack or buffer, but refer to direct causality since what happens in one directly affects what happens in the other. Loose couplings can best be characterised by ambiguity and flexibility in which the absence of intended connections can remain unobserved. Whereas loose couplings make it possible to display our own logic and interest in terms of causality, tight coupling restricts such attitudes. Unlike loose couplings that are more stable as they can accommodate shocks without destabilisation, tight couplings generally respond to a quicker and more disastrous fashion to perturbations.[433] Consequently, in terms of the properties we can state the following:

- *Linear interactions* – indicate spatial segregation and dedicated connections. They refer to attributes such as easy substitution, with only a few feedback loops. They also allow for single purposed and segregated control, since they rest on direct information that makes an extensive understanding possible.
- *Complex interactions* – are based on proximity and common mode connections. They display interconnectedness, which means limited substitution and many feedback loops. They require multiple and interacting controls that stand for indirect information and limited understanding.
- *Tight couplings* – do not make delays possible. Due to the underlying invariance of sequences there is only a small amount of slack. Should buffers and redundancies exist, they are mostly built-in features that allow only for limited substitution. Tight couplings mean that there is hardly any spatial and temporal separation between a cause and an effect.
- *Loose couplings* – allow for delays as the order of sequences is changeable. This results in extended and often unanticipated sets of alternative methods, slack and buffers in which substitutions are fortuitously available. In the case of loose couplings, causes and effects are separated both in time and space.[434]

10.1.2 Flattening and Projecting the Quadrant

It became clear that linear interactions refer to highly structured, logical, sequential, and predictable cause-and-effect relationships. In contrast, complex interactions offer less predictability due to the presence of unplanned and unforeseen relationships in terms of causality. Tight couplings can be described by high centralisation and rigidity, which allow for a close monitoring and a certain tolerance. Loose couplings mean decentralised operations and allow for a wide variety of outcomes in terms of effects.[435] Although the generic relationship between couplings and interactions allow for four possibilities, we suggest a different visualisation than in the form of a quadrant. Thus a flattened design is best suited to be projected

---

[433] Ibid., pp. 79-85.

[434] Ibid., pp. 86-92.

[435] Czerwinski, Tom: *Coping with the Bounds, Speculations on Nonlinearity in Military Affairs,* CCRP Publication Series, January 1998, pp. 89-92, 96-98; Perrow, p. 332.

on the continuum of war as depicted in Figure 11. War can roughly be subdivided into four vague, but interrelated areas such as simple, complicated, complex, and chaotic.[436] In general the more we move from the first area to the last, from tightly linear to tightly complex, the more the level of predictability based on causal relationships decreases and in the case of the latter, it can disappear entirely. The figure also shows that even if it is possible to discern causality in terms of physical effects such as *one bomb/one kill*, it is mostly impossible to see which way this particular effect relates to subsequent and desired psychological consequences.

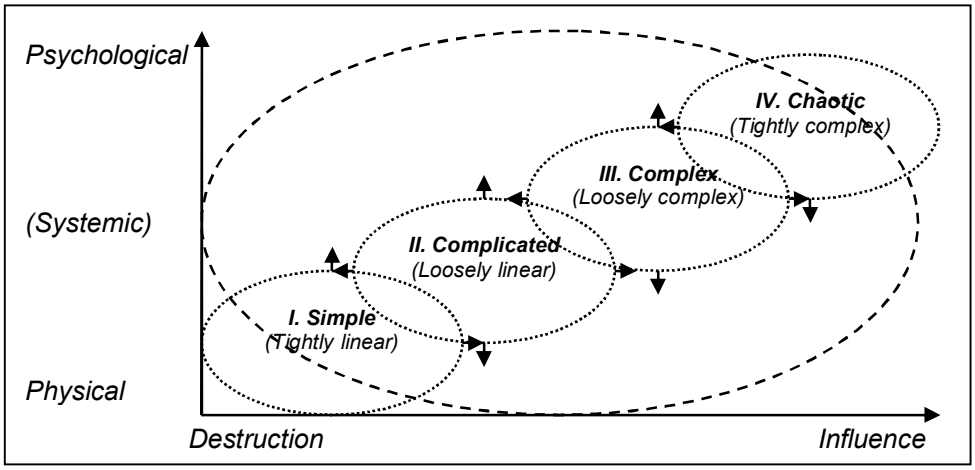

Figure 11: Czerwinski's flattened quadrant projected on the continuum of war

The increase in non-linearity and the growing instability of combinations result in difficult-to-decode causal relationships. Nevertheless the following explains some characteristics of the combinations:

- *Simple* – area I can be described as tightly linear and stands for linear causality indicating known causes and effects. We can discern clear and visible cause-and-effect relationships that allow for predictions. Due to their empirical nature, causal relationships are not open to dispute and planning for effects makes sense. Consequently, this area can be characterised by the predominance of centralised causes and centralised effects.
- *Complicated* – area II can be described as loosely linear and refers to knowable causes and effects. Although causal relationships exist, due to spatial and temporal separations they might not become fully known. The relationship between causes and effects are generally difficult to comprehend, which indicates limitations in terms of prediction. Planning for effects still makes sense, but we must take into account that centralised causes increasingly yield decentralised and unexpected effects.
- *Complex* – area III can be described as loosely complex. Cause-and-effect relationships might still exist, but they defy most attempts at categorisation or other analytical techniques. Effects can be perceived, but not predicted since their relationship is not open to any inspection. Both interactions and couplings indicate that causes and effects are mostly decentralised and appear coherent only retrospectively, but even then subject to debate.

[436] See Jobbagy (May 2005), pp. 47-57.

- *Chaotic* – area IV can be described as tightly complex. Here there are no visible cause-and-effect relationships, which indicate that causality is basically not perceivable. The amount of factors together with spatial and temporal separations makes prediction impossible, or allows only for very general terms. In this area it is not possible to plan for effects or discern causal relationships in a meaningful way.[437]

10.1.3 Friction and Chaos Depicted

The flattened quadrant made it possible to dissect war into four interrelated areas with different characteristics. Whereas in tightly linear systems everyone can detect causality, in loosely linear systems experts might detect causality. In loosely complex systems causality often becomes clear only retrospectively. Unfortunately, in tightly complex systems there is no discernible causality that can guide our actions.[438]

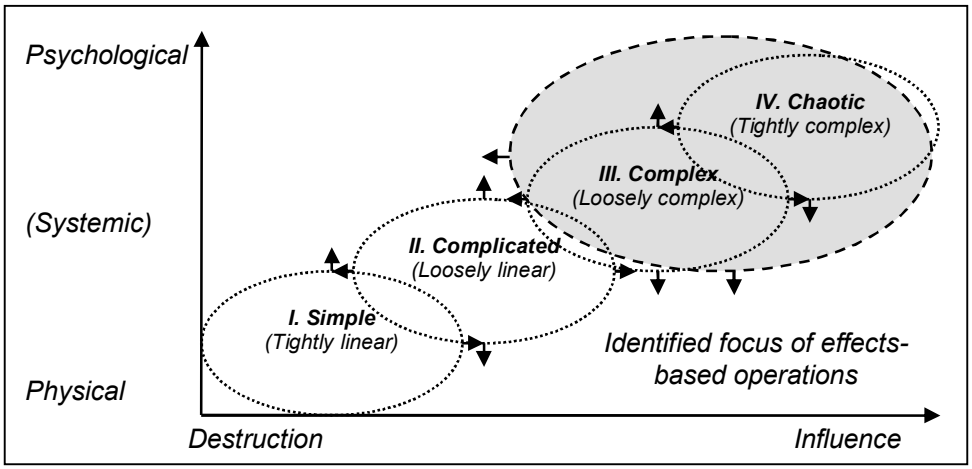

Figure 12: Effects-based operations and unpredictability

As depicted in Figure 12 the more we move towards tightly complex attributes the more unpredictability takes hold. Earlier we located effects-based operations in the upper right area of the continuum of war. Unfortunately, this is the very area in which it is very difficult or impossible to detect and exploit causality. Another problem with the concept comes from the fact that even the area in which we can discern causality, it interacts with areas that are inherently unpredictable. Consequently, as indicated earlier by friction and chaos, we must expect novelty everywhere and every time in war. This also means that the Clausewitzian assumption that in war everything is simple, but even the simplest thing can become difficult, takes hold. Unpredictability reminds us that if we have no firm basis for comprehending the initial state with all the factors that must be considered, we will equally have no basis to judge which of the possibilities should be regarded as desired effects:

---

[437] Kurtz, Cynthia F./Snowden, David J.: *The new dynamics of strategy: Sense–making in a complex and complicated world*, IBM Systems Journal, Volume 42, Number 3, 2003, pp. 468-469; Snowden, David/Stanbridge, Peter: *The Landscape of Management: Creating the context for understanding social complexity*, ECO Special Double Issue, Volume 6, Number 1-2, Fall 2004, pp. 144-145.

[438] Kurtz/Snowden, p. 472.

- In general we can say that even if effects-based operations worked, it would offer considerable promise only for physical effects, but in the case of psychological effects the concept is rather hopeless. Unfortunately, this is the area in which effects-based operations are claimed to offer the most benefits. It appears that in the case of systemic effects the concept touches the borderline that separates prediction from pure guesswork.
- Thus we can say that effects-based operations are generally good for creating desired physical effects, and might occasionally be good for generating desired systemic effects. However, in the case of psychological effects the best we can say is that the concept does not work well, but on occasion we might get useful information.[439]

The consequences of such a visualisation are serious since the figure indicates that the concept aims at exploiting causal relationships in an area in which it is either very difficult or even impossible to detect any sort of causality. Thus the figure also explains why it was so difficult to find a useful coercive mechanism that aims at influencing behaviour rather than destroying physical capability.

10.2 General Properties of Complexity

Dissecting the continuum of war based on interactions and couplings enables us to see the way structures are produced and dissolved in terms of causality. The four areas made it clear that the mechanism of war stands for a general unpredictability that can be described as follows:

- Moving towards the physical/destruction end-pole indicates direct causality and prediction, but the value of the effects achieved is normally seen as low.
- Although effects achieved around the psychological/influence end-pole have high values, they do not allow for predictions based on direct causality.

The properties indicate that in war all activities take place in an environment in which chaos constantly meets order in a disorderly way. Thus, the four areas display war as a phenomenon in which pre-order meets order in disorder, and occurrences move continuously back and forth in the continuum. Due to such attributes war can best be described by the term *complexity*. Similar to friction and chaos, complexity also denies the primacy of order and causality and the drive for efficiency and constant affirmation. In terms of unpredictability, complexity stands for freedom and openness that puts an emphasis on action and possibility. It is a whole in its own right in which actions complement each other when seen from the totality of the system.[440]

10.2.1 Describing Complexity

The structural analysis made it clear that war displays complex forms of causality in which we must take the various interdependences better into account. Links between causes and effects often become distant in time and space or can even disappear. Consequently, in the case we

---

[439] Lorenz, pp. 102-110.

[440] Lefebvre, Eric/Letiche, Hugo: *Managing Complexity from Chaos: Uncertainty, Knowledge and Skills,* Emergence, Volume 1, Number 3, 1999, pp. 7-15; Axelrod, Robert/Cohen, Michael D.: *Harnessing Complexity, Organizational Implications of a Scientific Frontier*, The Free Press, 1999, pp. 28-31; Lissack, Michael R.: *Complexity: the Science, its Vocabulary, and its Relation to Organizations*, Emergence, Volume 1, Issue 1, 1999, pp. 110-125.

proceed as "if simple linear links exist even if we do not know what they are, then we are likely to undertake actions that yield unintended and surprising results."[441] As indicated by friction about one and a half centuries ago and by the recent concept of chaos, complexity can also best be described as the result of many constituents that are interdependent in a non-linear way. They display a bewildering array of effects that possess a hierarchical structure spanning over several scales:

- Complexity appears as an emergent property in the continuum of war and comes from the constant interplay of chaotic and non-chaotic forces. Simply put, complexity arises from the sheer number of the constituents and their interdependencies.
- Complexity stands for a continuous evolution and adaptation containing a network of various alternatives. It cannot be represented based on reasoning and causality since the interactions and couplings of the constituents often produce unforeseeable results.[442]

In order to explore complexity properly, we must acquire a pluralistic world view that accommodates all the different kinds of phenomena co-existing side-by-side. Although the simplest way to think in terms of complexity is to assume a system that involves a huge number of interacting elements, the introduced structural analysis made it clear that complex systems cannot be defined only by the quantity of the interacting components. Complexity stands for a multitude of hierarchical layers in which any exclusive focus on individual agents means that important properties can easily be lost. Nevertheless, the four areas make it possible to deliver an explanatory framework that helps us better understand the consequences of our actions, and the spatial and temporal effects they generate.[443] A very important attribute of complexity can be defined as structural stability/instability. Whereas structural stability allows for analytical examination, structural instability can only be explained in a non-analytical way.[444] The laminar flow of events ceases to be stable and spontaneously turns into a turbulent flow. Structural instability stands for bifurcation in which new solutions emerge. Every such point contains an element of randomness or chance that makes impossible to predict which path the system will take. Consequently, at bifurcation points the system is beyond the threshold of stability and is under the rule of a chaotic mechanism that expresses an extraordinary sensitivity to initial

---

[441] Stacey, pp. 273-276 (quotation p. 275); More on the consequences see Tasaka, Hiroshi Dr.: *Twenty-first-century Management and the Complexity Paradigm,* Emergence, Volume 1, Issue 4, 1999, pp. 115-123.

[442] Levin, pp. 163-168; Baranger, Michel: *Chaos, Complexity, and Entropy, A physics talk for non-physicists*, pp. 9-11, Internet, accessed 24. 11. 2005, available at http://necsi.org/projects/baranger/cce.pdf; Cilliers, Paul: *Complexity and postmodernism, Understanding complex systems*, Routledge, 1998, pp. 2-5; Swenson, David X./Rigoni, David: *Ethical Problem Solving and Systems Theory: The Complexity Connection*, Systemic Practice and Action Research, Volume 12, Number 6, 1999, pp. 576-577.

[443] Nicolis, Grégoire/Prigogine, Iliya: *Exploring Complexity, An Introduction,* W. H. Freeman and Company New York, 1989, pp. 5-8, 31-32; Moffat, James: *Complexity Theory and Network Centric Warfare,* Information Age Transformation Series, CCRP Publication Series, September 2003, pp. xi-xiv, 1-10; Prigogine, Ilya/Stengers, Isabella: *Order out of Chaos, Man's New Dialogue with Nature*, Heinemann, 1984, pp. 131-137.

[444] Nicolis/Prigogine, pp. 93-98; Gove, p. 213; Moffat, p. 15. For a similar purpose another option would have been to display the so-called Lorenz equation. See Briggs, John/Peat, David F.: *Turbulent Mirror, An Illustrated Guide to Chaos Theory and the Science of Wholeness*, Harper & Row, 1989, pp. 53-65, 102; Lorenz, p. 147.

conditions. In terms of causality, links between causes and effects can be lost and it is not possible to identify "the specific consequences of a specific action, nor will we be able to identify the specific cause of a specific event."[445] As indicated by the four areas, any complex system can display both deterministic outcomes and random fluctuations. Around bifurcation points deterministic descriptions break down and explanations based on causal relationships do not make sense. Fluctuations completely upset the equilibrium of a system and as a result the number of possible effects can become very high. This constant shuffling between stability and instability explains why war can display "growth and decay, capture and domination, periods of opportunity for alternative developments followed by solidification of the existing domination structures."[446]

10.2.2 Depicting Complexity

In war areas with different characteristics overlap and constantly influence each other, which makes attempts to identify direct causality very difficult. Linearity goes together with non-linearity and stability always co-exists with complexity and chaos.

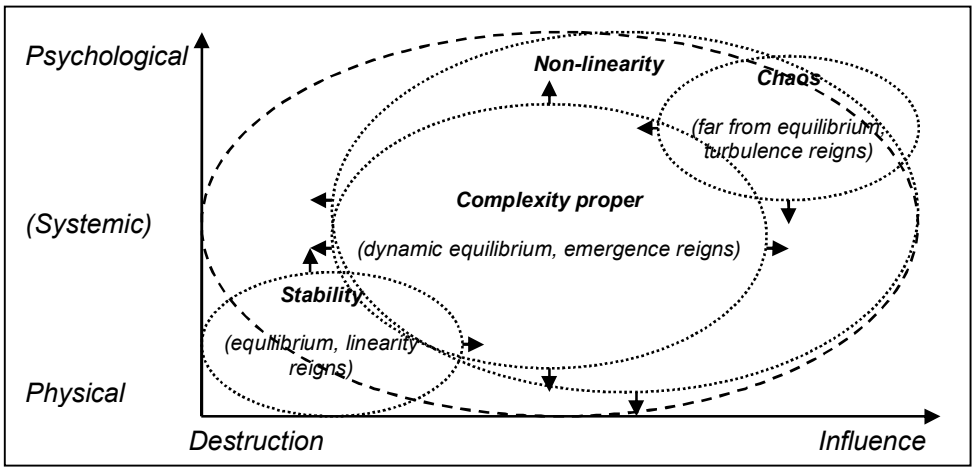

Figure 13 Overlapping characteristics of war

Whereas stability stands for simplicity and linearity reflecting a tight and linear relationship between causes and effects, non-linearity points towards chaos that can be described by extreme sensitivity to initial conditions indicating a tight, but complex relationship between causes and effects. The biggest area within the continuum of war can best be described as complexity proper, which stands for non-linearity, far-from-equilibrium conditions and emergence. Although war displays linear properties, its mechanism is mostly defined by non-linear attributes. Consequently, we must rethink regarding the basic mechanism that drives effects-based operations, and shift our reasoning away from prediction in terms of causality aimed at identifying desired effects.[447] War shows emergent and interactive attributes that come

---

[445] Prigogine/Sengers, pp. 140-141, 160-170, 177-179, 196-203 (quotation p. 203).

[446] Stacey, pp. 324-329 (quotation p. 324).

[447] Czerwinski, pp. 39-60; Briggs/Peat, pp. 174-180.

as a result of structured, but non-additive interactions. Figure 13 indicates war to be more than the sum of its constituents in which we always face a general unpredictability in relation to the input. The various combinations in terms of the constituents' interactions and couplings also mean that complex systems can be surprisingly stable and resilient. They can continuously adjust and adapt, which ability provides them with multiple and often unexpected paths that make causal explanations very difficult.[448] Instead of attempting to create idealised sets of problems that can be solved, war requires an everything-affects-everything-else mode to grasp the entire web of various connections. It is a phenomenon that cannot be examined through conceptual elegance reflecting rational thinking, deductive logic and analytical categorisation. Novelty can often come from simple properties producing emergent and unpredictable effects. Depending on the level chosen for examining war, we always confront with structures for which different laws, concepts, and generalisations apply. In contrast to the three common elements of effects-based operations, war stands for an infinite variety of possibilities and a general unpredictability regarding causes and their likely effects.[449]

10.3 Emergence and War

It became clear that *emergence* is the most important attribute of complexity. It works against causality since it refers to the way novel and coherent structures arise. Emergence cannot be predicted or anticipated in its fullness beforehand since it displays features not previously observed. Emergence is a holistic configuration that offers explanation into the dynamics of the system rather than explanation based on the system's parts alone. It does not allow for predictions based on deduction and causality. Emergence does not make it possible to explain the full richness of interactions and couplings, and the resulting multitude of possibilities. It is not a provisional construct, since the temporal and spatial dimensions of war point towards greater and greater unpredictability. Thus emergence does not allow exact prediction of future states and cannot be handled by analytical rationality. It produces unexpected or counter-intuitive results, which indicates that causes and effects are not only separate, but often disconnected in space and time. Consequently, we can say that under emergent conditions it becomes very difficult if not impossible, to say what causes what effect or to say what will happen in a specific place at a specific time. Emergence reflects attributes such as compensation and counter-action, which make most attempts to predict and plan for desired effects impossible, as such properties cannot be added together in a simple and system-wide way.[450]

10.3.1 Emergence and Environment

Unpredictability is further exacerbated by the fact that in an open and dissipative system such as war displaying emergent attributes, the environment must also be taken into account. The social

---

[448] Russ, Marion/Bacon, Josh: *Organizational Extinction and Complex Systems*, Emergence, Volume 1, Issue 4, 1999, pp. 75-79; Griffin, Douglas/Shaw, Patricia/Stacey, Ralph: *Knowing and Acting in Conditions of Uncertainty: A Complexity Perspective*, Systemic Practice and Action Research, Volume 16, Number 2, April 2003, pp. 302-304.

[449] Waldrop, Mitchell M.: *Complexity, The Emerging Science at the Edge of Order and Chaos,* Viking 1992, pp. 38-39, 60-63, 81-83.

[450] Goldstein, Jeffrey: *Emergence as a Construct: History and Issues*, Emergence, Volume 1, Issue 1, 1999, pp. 49, 57-62; Stacey, pp. 296-297; Axelrod/Cohen, pp. 11-15.

wave-front analysis made it clear that war is a social phenomenon that is linked to and interacts with, the surrounding social, cultural and political context. The environment is never static, but changes over time, which indicates that interactions stand more for what we do not know, and less so for the possibility to make accurate predictions in terms of causality. In order to get a better insight into the causal texture of the environment a simple matrix as below might be useful.

$$L_{11}, L_{12}$$
$$L_{21}, L_{22}$$

According to the matrix emergence arises as the interplay of L_{11} that refers to the processes found within the system, L_{12} and L_{21} both referring to interactions between the system and the environment, and L_{22} referring to processes and interaction within the environment itself. The matrix indicates that environmental interdependences of social phenomena such as war are often incommensurate with those connecting parts of the system. In other words, the environment is not just *out there*, but constantly changes in ways no one can anticipate.[451] Environmental factors also indicate that emergence stands for two sorts of unpredictability. Whereas in spatial terms it stands for the fact that properties at a certain level cannot be predicted from other level properties, in temporal terms it means unpredictability from the properties that constitute the preceding condition. Consequently, we can state that emergence:

- Creates new properties regardless of the substance involved since it relates levels to each other by denoting the very passage connecting them.
- Reminds us that in a complex phenomenon such as war several levels co-exist simultaneously and interpretations based on causality can lead to mistakes.
- Poses a challenge to the notion of causality since it refers to something that disrupts the notion of causality and cracks the power of causal explanations.
- Stands for a qualitative change suggesting that causality and randomness are always interwoven in an intriguing way.
- Indicates novelty in the form of new and random solution paths open to chance occurrences that do not allow for mechanical explanations.
- Although it might allow for the prediction of certain structural features in general terms, it does not help predict details of the future in terms of desired effects.[452]

---

[451] Jobbagy (May 2005), pp. 11-23; Moffat, p. xiii; Emery, F. E./Trist, E. L.: *The Causal Texture of Organizational Environments*, Human Relations, Number 18, 1965, pp. 22; Green, David G./Newth, David: *Towards a theory of everything? – Grand challenges in complexity and informatics*, Complexity International, Volume 8, 2001, p. 1, Internet, accessed 25. 10. 2005, available at http://journal-ci.csse.monash.edu.au/ci/vol08/green05/; Jervis, Robert: *Complex Systems: The Role of Interactions*, in: Alberts, David S./Czerwinski Thomas J.: *Complexity, Global Politics and National Security*, National Defence University, Internet, accessed 25. 11. 2003, available at www.dodccrp.org/comch03.html.

[452] Emmechie, Claus/Køppe, Simo/Stjernfelt, Frederik: *Explaining Emergence: Towards an Ontology of Levels*, Journal for General Philosophy of Science, Volume 28, 1998, pp. 83-100; Goldstein, Jeffrey: *Causality and Emergence in Chaos and Complexity Theories*, in: Sulis, W./Combs, A. (eds.): *Nonlinear Dynamics in Human Behaviour*, World Scientific, 1996, pp. 163-182.

10.3.2 On Complex Adaptive System

Emergence opens both the door for a better understanding of unpredictability and a conceptualisation of war as a complex adaptive system, which can also be found in four of the introduced approaches to effects-based operations. Although the notion of a complex adaptive system generally applies to war since it refers to entities that show emergent properties across time and space, we must also acknowledge that not all emergent systems are adaptive. Complex adaptive systems display multiple interacting scales that mostly defy the utility of deductive and analytic categorisations. Consequently, thinking in terms of a complex adaptive system defies most assumptions regarding direct causality, identifying desired effects, and linking various levels in a direct and comprehensive manner. Retrospective analysis is feasible in a complex adaptive system, but prediction is only possible in the most general terms, which makes it very hard to see the consequences of our actions. The term *adaptation* indicates a process that constantly changes, as the system never settles down. Although a complex adaptive system might be surprisingly stable, it is never in equilibrium.[453] War perceived as a complex adaptive system implies that the belligerents do not simply follow certain rules, but by changing those rules they create emergent futures. They are capable of learning from non-linear feedback and produce unpredictable actions. A complex adaptive system thrives best at the edge of stability and instability, which promotes creativity. A complex adaptive system stands for ambiguity, paradox and the anxiety it generates. Seeing war this way is *uncomfortable* since a complex adaptive system cannot be planned or intended:

- The most important consequence of a conceptualisation based on a complex adaptive system is that long-term outcomes are unknowable since the ability to self-organise spontaneously can result in disappearing causal relationships.
- Emergence and adaptation explain why the general unpredictability of war takes hold if we want to get a grip on the future pattern it might display, or to reduce that pattern to its constituents.[454]

10.3.3 Self-Organisation Everywhere

War conceptualised as a complex adaptive system means that its structures come from a process in which the constituents interact in an inherently complex way. Structures come as a result of *self-organisation*; therefore predictions based on direct causality can only be possible in the short term. The spontaneous adjustment of a complex adaptive system involves complex interactions with so many factors that control becomes impossible. Self-organisation means that a complex adaptive system is able to dynamically adapt to changes even if those changes appear in an irregular fashion. Although self-organisation happens at all levels of the system, the components operate on local information and general principles that have only limited content for the system as a whole. Self-organisation runs against most assumptions of direct causality and reminds us that war is a phenomenon in which the operational conditions make it mostly impossible to see the output without considering the mechanism by which it is produced. Unfortunately, as previously stated, war's development might be determined by its mechanisms, but cannot be predicted as the output does not make it possible to find reliable rules.

---

[453] Levin, pp. 3-4, 11; Axelrod/Cohen, pp. 7-9; Gell-Mann, pp. 16-21, 54-56, 69-70, 72-74.

[454] Stacey, pp. 334-345; Coveney, Peter/Highfield, Roger: *The Arrow of Time, The Quest to Solve Science's Greatest Mistery*, Flamingo, 1991, pp. 182-190.

Consequently, in terms of causal relationships we can say that a complex adaptive system displaying self-organising behaviour stands for complex and circular causality in which "causes and effects cannot be mapped linearly; similar causes can have different effects and different causes similar effects; small changes of causes can have large effects, whereas large changes can also result in only small effects (but, nonetheless, it can also be the case that small causes have small effects and large causes large effects)."[455] Self-organisation indicates that unpredictability of war generally takes hold. It also gives us a feel as to why the bulk of military coercion theories failed, and why some of the proponents of effects-based operations call for an essentially vacuous process they describe as *hard thinking*. Consequently, similar to friction and chaos, we can say that complexity in general, and the complex adaptive system and self-organisation in particular, indicate a rather low practical ceiling for effects-based operations.

10.3.4 Increasing Structural Instability

The concept of effects-based operations emphasises deductive reductionism and causal laws attempting to predict certain desired effects. The supporting assumption is that war displays order and equilibrium, the possibility for rational choice, and the ability to steer and control events. In contrast war as understood by Clausewitz, stands for variety and novelty in which certain properties remain inherently unknowable to the human mind. Although war can be described in general terms using causal relationships, effects that go beyond the immediate spatial and temporal levels cannot be predicted with any accuracy. Understanding war as a complex adaptive system indicates something very different than the fundamental assumptions of effects-based operations, namely that it is only possible to come to grips with some things – especially those things which are local to us both in space and time. Friction, chaos and complexity suggest that everything in war is interrelated and all we can attain is a temporary and partial interpretation. They also remind us that we often confuse causation with correlation, and simulation with prediction. Whereas the former refers to our preference for creating retrospective validation to identify best practices, the latter points to the fact that even if we can simulate something it does not obviously mean that we can equally predict its future.[456] War is a phenomenon full of discontinuities and uncertainty, which indicate a general unpredictability that can make both individuals and organisations disoriented. This uncomfortable feeling explains why a concept such as effects-based operations appears attractive for so many. The international arena has been a messy place since the demise of the bipolar world-order and it should not come as a surprise that effects-based operations have gained an astonishing attention in the political-military community. During turbulent times in which orientation becomes difficult, humans increasingly turn to panaceas for advice. In cases we do not understand or can

---

[455] Cilliers, pp. 89-95; Krohn, W./Küppers, G.: *Self-organization: A new approach to evolutionary epistemology*, in: Hahlweg, K./Hooker, C. A. (eds.): *Issues in Evolutionary Epistemology*, State University of New York Press, 1989, pp. 155-156; Quotation in Fuchs, Christian: *Structuration Theory and Self-Organization, Systemic Practice and Action Research*, Volume 16, Number 2, April 2003, p. 135.

[456] Flood, Robert L.: *Knowing the Unknowable*, Systemic Practice and Action Research, Volume 12, Number 3, 1999, p. 247-252; Kurtz/Snowden, pp. 462-463; Snowden/Stanbridge, p. 146; Stacey, pp. 346-347.

cope with, we often look for simple or simplistic solutions that promise quick help.[457] As depicted in Figure 14, even in the framework of the proposed and extended conceptualisation of effects-based operations covering the full continuum of war, we must constantly balance in terms of ends/means relationship. Friction, chaos and complexity indicate that we face unpredictability both in terms of what we are trying to achieve (effect), and in terms of how it becomes possible to achieve what we want to (cause).

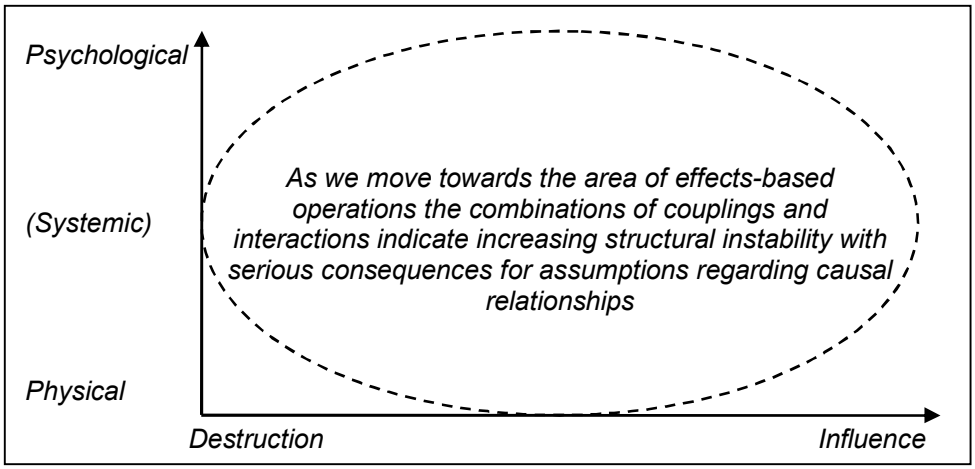

Figure 14: Predictability and causality in war

War stands for a general unpredictability in terms of ends and means. Several different futures are possible and there is not always time for mechanical, deductive systemic analyses aimed at detecting direct causality. The most important message of unpredictability is that instead of focusing on certain desired effects, we should rely on the ability to respond consistently to the unpredictable nature of war. War cannot be waged based on single and prescriptive models. It requires that we evolve rapidly in order to handle dynamic and changing situations similar to the *biological evolution* of species.[458] The serious contradiction between the basic assumptions of effects-based operations and the unpredictable nature of war naturally raises the demand for an enhanced conceptualisation. Friction, chaos and complexity indicate that we must be satisfied with understanding certain general features in terms of correlation, rather than attempting to discover a mechanism that links causes with effects directly. Thus friction, chaos and complexity should be regarded as opportunities that can explain qualitative behaviour instead of inaccurately predicting futures in terms of desired effects.[459]

---

[457] Ackoff, Russel T.: *Fundamentalism and Panaceas,* Systemic Practice and Action Research, Volume 14, Number 1, 2001, pp. 3-10; Christensen, Clayton M./Raynor, Michael E.: *Why Hard-Nosed Executives Should Care about Management Theory*, Harvard Business Review, September 2003, pp. 67-74; Rosenau, James N.: *Many Damn Thing Simultaneously: Complexity Theory and World Affairs*, and Mann, Steven R.: *The Reaction to Chaos*, both in: Alberts/Czerwinski.

[458] Snowden, David: *The Paradox of Story*, Scenario and Strategy Planning, Volume 1, Issue 5, November 1999, pp. 16-20.

[459] Emmeche C./Køppe S./Stjernfelt F. (1997): *Explaining emergence: Towards an ontology of levels*, Journal for General Philosophy of Science, Volume 28, 1997, p. 116.

11 Towards an Organic Model

11.1 Consequences of Complexity Theory

This chapter will show that similar to the biological evolution of species also war can be seen as a co-evolutionary process. Friction, chaos and complexity stand for a lack of accurate prediction, which indicates that war requires constant adaptation. They impose adjustment on the belligerents, which does not make it possible to know all values for all relevant variables beforehand. Thus similar to biological evolution, perpetual novelty is a typical feature of war. Prediction is generally difficult and when the enemy learns or adapts the difficulty increases enormously. Seeing war this way means that even if we were able to discern all the individual constituents, direct links in the form of causal relationships would not provide for convincing information regarding the underlying properties. Consequently, the mechanism of war cannot be explained as the sum of these properties. Comprehending all relationships between causes and effects exceeds anything predictable. War is context-dependent and non-linear in which the whole is always more than the sum of the parts. The same phenomenon understood in a given context can often become obscure in another. Even if we detected laws applicable for one level, they might become entirely upset at another. Consequently, if we want to stick to the term effects-based operations our focus must shift from end-effects towards transitional effects and we must regard the means applied equally important as the ends sought. In other words, we have to acknowledge that whatever the effects achieved in war they reflect combinations that come from a trial-and-error mechanism rather than a careful process of optimising.[460]

11.1.1 War as Complex Human Phenomenon

The earlier chapters detected a dangerous gap between the promises of effects-based operations and the assumptions upon which the concept is based. The current understanding and supporting argumentation display major conceptual and methodological weaknesses that are dangerously disconnected from the characteristics of war. This inconsistency indicates that effects-based operations stand for a concept that, in its current conceptualisation, lacks both substance and meaningful content. In an age of a desperate search for finding useful concepts for developing war-fighting capabilities the idea of referring to effects, especially to higher order ones in the psychological domain is nothing more than a fashionable mantra. It is empty, harmful and does not take war's frictional, chaotic and complex reality into account.[461] Much of the continuum of war displays non-linearity that stands either for a dynamic equilibrium or far from equilibrium conditions. In contrast we identified effects-based operations as a conceptualisation of war that reflects an equilibrium-oriented thinking. War is addressed in natural scientific terms based on the principle of causality, which assumes that it is possible to predict end-states based on analytical rationality. Unfortunately, in the case of a complex human phenomenon such as war analytical skills based on direct causality are valid only within a limited range. Beyond that,

---

[460] Holland, John H.: *Emergence, From Chaos To Order,* Oxford University Press, 1998, pp. 42-45, 121-123, 185-187, 238-246.

[461] Jobbagy, Zoltan (Maj.): *Effects-Based Operations and the Problem of Thinking Beyond: A Critical Reflection,* TNO Report, Clingendael Centre for Strategic Studies, CCSS-2006-001, March 2006.

they are not able to deliver satisfactory descriptions as we increasingly deal with emergent and self-organising properties.[462]

11.1.2 Equilibrium and Disequilibrium

Western military thinkers prefer to address war mostly in a way that is closely related to the methodology found in various natural scientific fields. Even Clausewitz used the vocabulary of natural science. In order to understand this preference we must go back to the 17th century. Normal scientific thinking as an originally Western phenomenon is based on the Newtonian world view of synthesis and emphasises actions *on* the environment by promising better ways to organise and exploit the world. Its biggest payoff is to arrange human natural and social life, which enabled and drove the force of industrial revolution. However, despite all the contributions to human social and economic developments scientific homogeneity emphasising criticality and verification has never been able to get entirely rid of instability. As we made it clear even abstract mathematical precision and rigour are approximate descriptions of imprecise natural processes. In a complex world and especially in the case of a complex human phenomenon such as war displaying multi-layered problems, an approach is needed that is less rigid and more flexible, less artificial and more natural, less mechanistic and more organic; one that emphasises actions *in* the environment.[463] Natural science and its supporting paradigms also ignore most human attributes that constitute a very important part of life. Clausewitz was not short in emphasising that apprehensions, sensations, perceptions, impulses, and emotions are essential ingredients of war. Unpredictability of war also forces us to think holistically and in terms of opposites, in which one side cannot be right at the expense of the other. Thus the interplay of opposite forces such as stability and chaos must be taken better into account in order to help redirect our intuition. As the continuum of war indicates, a complex adaptive system allows for polarities to manage rather than problems to solve. Thus a more sober look at the real world can reveal some new insights regarding the nature of most human activities including that of war.[464] However, such an approach means less certainty and challenges our inherent preference for clear boundaries representing distinct and potentially solvable problems.

11.1.3 Thinking Outside the Box

Any analysis regarding the relationship between certainty and uncertainty, stability and chaos can easily end with the conclusion that the emphasis on the former has always been dominant in modern Western thinking. However, focusing on certainty only is analogous with a life spent in the box. It excludes the different and includes the similar without questioning the latter. An exclusive focus on certainty means that nothing is tolerated beyond its contours. In contrast, war is full of evidence that certainty and uncertainty always mix and are separated only by boundaries in our thinking.[465] As displayed in Figure 15 much of war is non-linear and composed of waxing and waning structures that constantly emerge and change. Consequently, it always displays qualitatively different behaviours. War shows emergent and self-organising attributes

---

[462] Beinhocker, Eric D.: *Strategy at the Edge of Chaos,* The McKinsey Quarterly, Number 1, 1997, p. 25.

[463] Prigogine, Ilya/Stengers, Isabelle: *Order Out of Chaos, Man's New Dialogue with Nature,* Heinemann, 1984, pp. 37-40.

[464] Dent, Eric B.: *Complexity Science: a Worldview Shift,* Emergence, Vol. 1, Issue 4, 1999, pp. 10-13.

[465] Molderez, Ingrid: *Freedom and Uncertainty*, Emergence, Volume 1, Issue 3, 1999, pp. 84-91.

with changing and evolving boundaries; therefore our knowledge gained is always limited and provisional. Boundaries depend on the level of aggregation chosen, reflect the limitations of human cognitive resources, and agree with our inherent need to reduce complexity. Unfortunately, since a holistic description of the world is impossible all descriptions must be essentially *metaphoric* in order to comprehend the complex relationship between various natural and social boundaries.[466]

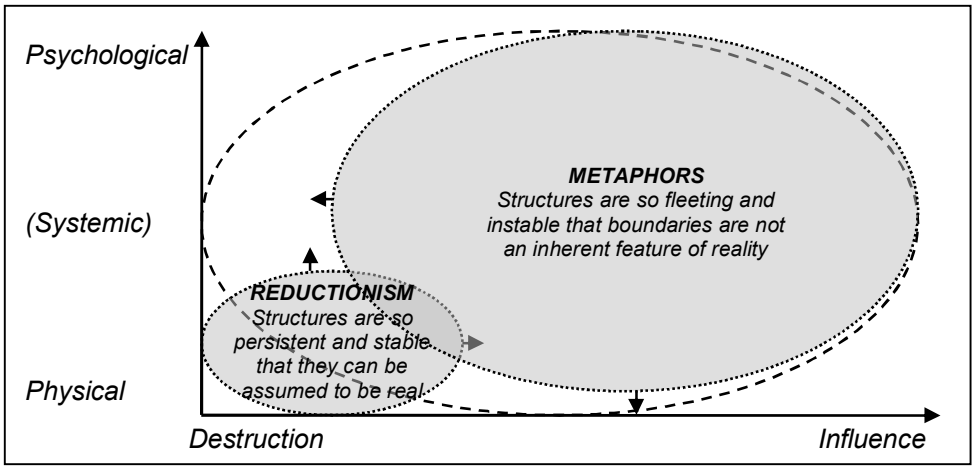

Figure 15: Boundaries and the continuum of war

Boundaries also remind us that coping is often possible, but control is not. Issues such as global warming together with various environmental disasters painfully display that boundaries are not there to separate. Boundaries connect, and most of our actions only disturb complex adaptive systems on various scales. Solving problems in a given area can cause new and unexpected problems in others, often in fields that are not directly related. Due to the intricate relationship of interactions and couplings, desired effects always induce unexpected, unwanted and uncontrollable consequences. Thus modelling the world and a complex human phenomenon such as war, based on a logical framework focusing on direct causality is inappropriate. As modern science evolved it produced ever-increasing specialisations. The disciplines moved deeper and deeper into their respective fields resulting in high and impenetrable walls that divided up sources and targets of their efforts. In contrast conceptualising war as a complex adaptive system means that we appreciate it as an organic whole and not as dissected entities. This approach shows similarities with the idea of a *war-fighting ecosystem* as coined in some recent military publications.[467]

---

[466] Richardson, Kurt, A./Lissack, Michael R.: *On the Status of Boundaries, both Natural and Organisational: A Complex Systems Perspective,* Emergence, Volume 3, Issue 4, 2001, pp. 40-49.

[467] Levin, Simon A.: *Complex Adaptive Systems: Exploring the Known, the Unknown and the Unknowable,* Bulletin of the American Mathematical Society, Volume 40, Number 1, 2003, p. 4; Alberts, David S./Gartska, John J./Stein, Frederick P.: *Network Centric Warfare, Developing and Leveraging Information Superiority,* 2nd Revised Edition, CCRP Publication Series, July 2002, p. 83.

11.2 Metaphors and the Military

Taking full advantage of *metaphors* requires that we first clarify the term. Thus a metaphor is an implied comparison or a figure of speech in which a word denoting a certain object or action is used for another in order to suggest an analogy. The very strength of metaphors is that they involve both sources and targets surrounded by an aura of meanings and associations. Metaphors enlarge our perception by producing insightful connections and interpretations. They offer a conjunction by activating a train of associations. Metaphors place the target in a new light, which might lead to a profound re-conception. Powerful metaphors offer more than a list of associations by emphasising some aspects whilst diminishing others. They enable the individual to see and experience new connections. In sum, metaphors are "comparisons that help give shape and form to abstractions through images that are not dependent on the weaker "like" or "as" foundations of the simile."[468] Metaphors are figurative expressions in which a word or phrase designating one thing is used to designate another in the form of an implicit comparison. Metaphors make a qualitative leap from reasonable, prosaic comparison to identification or fusion of two objects as the resulting new entity possesses the characteristics of both. Traditionally, the military has loved metaphors and military writings are full of them acting as frames of reference for facilitating discussion and developing ideas.[469] Thus metaphors can be extremely powerful and much more significant than normally considered. Although metaphors are usually paradoxical statements, they can be very robust. They are literally false according to abstract rationality, but true according to imaginative rationality. Metaphors form essential *as-gates* in the human cognitive process since they enable the understanding of one thing in terms of another. Metaphors are indicators of a network of meanings that all affect the processes of perception and conception. As evolving things, they are open to novelty even mutation. They are able to capture the underlying processes of other evolving entities surprisingly well. Metaphors can help us explore an interesting possibility space characterised by contingency and feedback. Metaphors can also be superior to analytical models when the phenomena of interest are impossible to control or the necessary assumptions unsure.[470] Thus metaphors appear to be helpful aids when dealing with a complex adaptive system such as war. Four general levels of metaphors can be differentiated:

- *Transfer* – level one means the transfer of a single term into another context in order to create new meaning.
- *Construction* – level two is the construction of analogies as part of a specific theory or a general and systematic inquiry to elucidate phenomena.
- *Unification* – level three stands for a unifying view of an entire paradigm, often symbolised by a specific term that refers to the whole frame of understanding under a given paradigm.

---

[468] Gove, p. 1420; Holland (1998), pp. 202-210; Saperstein, Alvin M.: *Complexity, Chaos, and National Security Policy: Metaphors or Tools?*, in: Alberts, David S./Czerwinski, Thomas J. (ed.): *Complexity, Global Politics, and National Security,* National Defence University, June 1997, Internet, accessed 25. 11. 2003, available at www.dodccrp.org/comindex.html; Quotation in Jablonsky, David: *Time's Arrow, Time's Cycle: Metaphors for a Period of Transition*, Parameters, Winter 1997-98, p. 4.

[469] Ilachinski (1996a), pp. 44-45; Durham, pp. 38-40.

[470] Beyerchen, Alan D.: *Clausewitz, Nonlinearity, and the Importance of Imagery*, in: Alberts/Czerwinski; Czerwinski, Thomas J.: *Coping with the Bounds, Speculations on Nonlinearity in Military Affairs,* CCRP Publication Series, May 1998, pp. 63-70.

- *Merger* – level four can be seen as the most comprehensive in which science itself is understood as an irreducible metaphor.[471]

Based on the idea of the evolving biosphere we propose the *Organic Strategic Ecosystem* metaphor. Organic since it is born out of complex adaptive systems theory that emphasises war as a conflict between two self-organising, living and fluid-like entities. Strategic since the many mutually interacting and co-evolving parts form emergent possibilities that have relevance on the strategic level in the form of victory and defeat. Ecosystem since biological evolution serves as the basis for conceptualising war as an open ended and dynamic system.

11.2.1 Biological Evolution as a Complex Adaptive System

Conceptualising war in the framework of an Organic Strategic Ecosystem resembles similarities with processes found in biological evolution. Both emergence and self-organisation represent non-linear attributes pointing towards spontaneous order rather than a gradual process. We made it clear earlier that the continuum of war refers to an area that can be characterised by two end-poles such as stability and chaos. Whereas chaos is a randomising force that points towards a disordered state, stability stands for equilibrium and represents spontaneous crystallisation and a high degree of order.[472] Minor changes can sometimes cause catastrophic outcomes in such a system's behaviour; therefore it appears naturally that selection as a steady optimising force alone cannot drive evolution. Selection is powerful, but not too powerful, which indicates evolution to be an unpredictable process consisting of detailed bits of selection and improbable ad-hoc events. As a consequence, biological evolution exhibits spontaneous order even in the absence of any selective force. Understanding this mechanism requires the introduction of two interrelated attributes such as *fitness* and *co-evolution*, both indicating simultaneous adaptation and change.[473] They allow biological evolution to be depicted in the form of a landscape, also called the *fitness landscape*. Its surface is continually evolving and changing due to the action/reaction cycles of the species inhabiting them. Similar to the unpredictability of war dynamic and deforming fitness landscapes also defy clear causality by implying the impossibility of continuing and exploiting current capabilities through constant refinements. There is no guarantee that current locations of high fitness symbolised by high peaks remain unchanged over time since their values can alter significantly. Thus the challenge is to strike an appropriate balance between exploiting locations of high fitness and constantly exploring new locations that might have an even higher value. Conceptualising war this way means that similar to biological species we move along an evolutionary path or trajectory representing effects-based operations.[474]

---

[471] Ilachinski (1996a), pp. 45-49.

[472] Kauffman, Stuart A.: *Antichaos and Adaptation,* Scientific American, August 1991, p. 64.

[473] Kaufmann, Stuart A.: *At Home in the Universe, The Search for Laws of Self-Organisation and Complexity,* Oxford University Press, 1995a, pp. 151-152; Waldrop, Mitchell M.: *Complexity, The Emerging Science at the Edge of Order and Chaos,* Viking 1992, pp. 102-110; Kaufmann, Stuart A.: *Adaptation on Rugged Fitness Landscapes*, in: Stein, Daniel L. (ed.): *Lectures in the Sciences of Complexity,* Addison-Wesley Publishing Company, 1989a, p. 527.

[474] Brabazon, Tony/Matthews, Robin: *Organisational Adaptation on Rugged Landscapes,* pp. 3-5, Internet, accessed 15. 02. 2004, available at http://business.kingston.ac.uk/research/intbus/paper2.pdf.

11.2.2 Landscapes, Fitness, and Effects

The proposed metaphor makes it possible to take the frictional, chaotic and complex reality of war better into account. The inherent and age-old relationship between the military and landscapes supports such an approach in many respects:

- The literal interpretation understands landscape as terrain with its geographical features that have always been influential for the conduct of war and warfare.
- The first level of abstraction is embodied by the topographical map that directly refers to geography since it depicts the physical landscape in standard symbols.
- The second level of abstraction is representation by metaphor and indicates political, economic, and cultural landscapes that have no physical basis.
- The third level of abstraction allows us to understand landscapes as tools for analysing and modelling complex problems.[475]

The proposed conceptualisation relies on the second level. Fitness originally described the relative success of a species in relation to others in its environment. No fitness landscape is fixed, but changes in response to the actions of other species with which it co-evolves. A species tries to optimise its fitness by getting onto a peak that symbolises a relative competitive advantage. Similar to the unpredictable mechanism of war, fitness emphasises a constantly changing environment in which a species' suitability to the circumstances often alters in a subtle and dramatic way.[476] Since such attributes resemble situations found in war, the notion of an *effects landscape* in which peaks stand for effects, is extremely suited for a conceptualisation. Although effects landscapes differ from each other, they show a number of regular properties and structures. In most cases heights of different peaks are correlated in such a way that peaks differing slightly are near each other. As the environment and the enemy change, the value attributable to any given effect will also change. Consequently, the heights of the peaks in the landscape move constantly up and down over time indicating that one effect regarded as valuable today might probably be of little help tomorrow.[477] If we can better understand the underlying properties of such an imaginary landscape it becomes possible to think of effects-based operations as a search process to find high peaks. This powerful metaphor helps us conceptualise effects-based operations in a way that not only acknowledges the frictional, chaotic and complex reality of war, but also takes full advantage of it.

---

[475] Dockery, John T./Woodcock, A. E. R.: *The Military Landscape, Mathematical Models of Combat,* Woodhead Publishing Limited, 1993, pp. xiv-xv.

[476] Glenn, Kevin B. (Maj.): *"Complex" Targeting: A Complexity-Based Theory of Targeting and its Application to Radical Islamic Terrorism*, School of Advanced Airpower Studies, Air University Maxwell AFB, June 2002, pp. 40-41; Osinga, pp. 140-142.

[477] Jobbagy, Zoltan (Maj.): *Literature Survey on Uncertainty, Non-linearity, Complexity and Chaos. A Ph. D. study on measuring military effects and effectiveness,* TNO Report, FEL-04-B061, June 2004, pp. 183-184.

12 Properties of Fitness Landscapes

12.1 Dynamic Law in War

In the framework of the Organic Strategic Ecosystem we conceptualise war as a complex adaptive system in which effects-based operations represent an approach that aims at finding an appropriate combination of effects. Thus we approach effects-based operations as a complex optimisation process. Effects form a large pool of possibilities in which the combination of effects achieved decides over victory and defeat. As the actions of the belligerents develop, high value effects can become obsolete and effects with originally low significance can turn increasingly powerful. In this dynamic give-and-take process, similar to biological evolution the belligerents continuously adapt by means of compensation and substitution. As indicated by the continuum of war and depicted in Figure 16, the conflict shuffles back and forth between orderly and chaotic regions reflecting the Clausewitzian observation that every "action in war is not continuous, but spasmodic. Violent clashes are interrupted by periods of observation, during which both sides are on the defensive."[478]

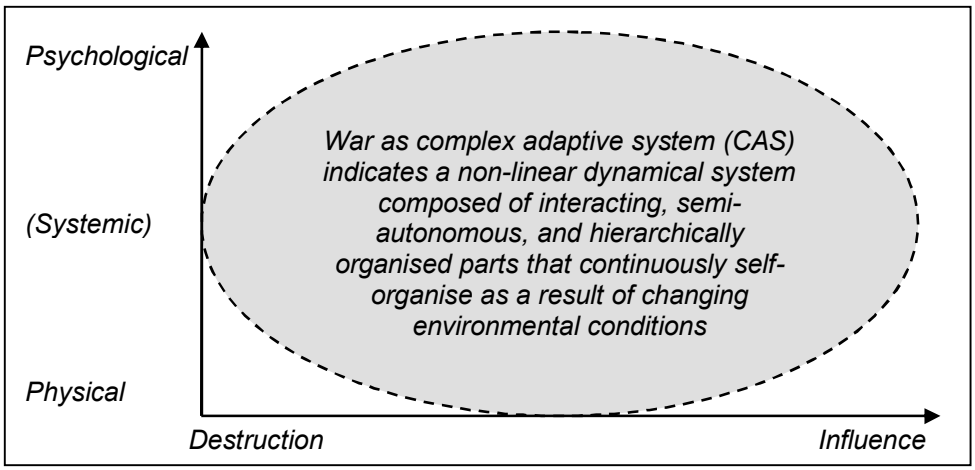

Figure 16: Continuum of war perceived as complex adaptive system

He defined this attribute the *Dynamic Law in War*. Thus in campaigns, periods of inaction and response change with periods of action as "periods of active warfare [would] always be interspersed with greater or smaller periods of rest".[479] The period of rest meant for him stability and equilibrium including phenomena such as physical and psychological forces, circumstances and motives. Although this continuous cycle defined war fully, Clausewitz emphasised that the "state of crisis is the real war; the equilibrium is nothing, but its reflex."[480]

---

[478] Quotation in Clausewitz, p. 257.

[479] Quotation in ibid., p. 260.

[480] Quotation in ibid., p. 262.

12.1.1 Towards the Biology of War

Due to war's frictional, chaotic and complex reality prediction is generally limited. There are so many variables that must be taken into account that the combination of effects reflects a distribution of potential outcomes rather than a unique outcome. Moreover, distributions overlap so that approaches attempting to optimise make more sense than those attempting to maximise. Consequently, success and victory in war can be seen as a realised positive outcome rather than a maximum one. The greater the uncertainty the greater the possibility, that victory is a combination of relative superiority and fortuitous circumstances. Chance in the form of trial-and-error also limits the selection of any meaningful criteria for achieving maximum effects. In war there is no guarantee that a particular outcome in the form of desired effects is really the best one. Once chance forces select a particular path it often *locks in* regardless the quality of other possibilities. Consequently, there are many possible solutions to the same problem and sometimes small, fortuitous, and trivial events determine the one event that becomes dominant.[481] Darwin recognised in his book *On the Origins of Specie*s that genetic usurpation and endemic warfare share similarities as both are important forces in evolution and human history. In chapter three he drew an analogy between war, battle and natural selection and saw evolution as a "[b]attle within battle [that] must ever be recurring with varying success." This analogy made him conclude that "from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows." Thus evolution was for him a "great and complex battle of life", which together with the *Law of Battle* for survival formed a recurrent pattern also in his second epic work *The Decent of Man*.[482] The seven approaches described effects as interrelated phenomena, which also mean that in biological terms they interact. Like living species effects may gain strength or lose momentum thus resembling attributes of the organic world. Consequently, effects-based operations can be interpreted as a process of filling niches with a combination of effects that are fitter than those of the enemy.[483] Thus soldiers might share similar problems with ecologists as both try to find a function that matches the crude reality of life. The American military thinker John Boyd also advocated that evolution by natural selection and the conduct of war are intimately related. Both reflect conflict, survival, and conquest in a very similar and fundamental way. Stability and chaos mark the two end-poles of war in which the degree of non-linearity defines both the quantity and quality of the outcome. By finding small areas of order sometimes it is possible to achieve equilibrium, but occasionally no equilibrium can be reached at all. When we understand effects-based operations as a process that includes a trial-and-error mechanism,

---

[481] Alchian, Armen A.: *Uncertainty, Evolution, and Economic Theory,* The Journal of Political Economy, Volume 58, Number 3, June 1950, pp. 211-214; Arthur, Brian W.: *Positive Feedbacks in the Economy,* Scientific American, February 1990, pp. 92-94.

[482] Crook, Paul: *Darwinism, war and history, The debate over the biology of war from the 'Origin of Species' to the First World War,* Cambridge University Press, 1994, p. 20; Darwin, Charles R: *On the Origin of Species, By Means of Natural Selection, Or the Preservation of Favoured Races in the Struggle for Life*, John Murray, 1859, pp. 73-88, 490 (quotations pp. 73, 80, 490); Darwin, Charles R.: *The Descent of Man, And Selection in Relation to Sex*, John Murray, 1871, Volume 2, pp. 40-51, 98, 102, 123, 238, 239-315, 323-326, 403.

[483] De Greene, Kenyon: *Field-Theoretic Framework for the Interpretation of the Evolution, Instability, Structural Change, and Management of Complex Systems,* in: Kiel, Douglas L./Elliott, Euel: *Chaos Theory in Social Sciences, Foundations and Applications,* The University of Michigan Press, 1997, pp. 275-277, 288.

insights coming from evolutionary biology are very helpful as even a modest pool of effects can show an enormous amount of possible combinations. Clausewitz also pointed out that "the vast, the almost infinite distance … between cause and its effect, and the countless ways in which these elements can be combined" demand things to be seen in a comprehensive fashion.[484]

12.2 Shifting Balance of Evolution

When biologist Sewell Wright wanted to understand the properties of gene mutation he concluded that under bi-parental reproduction even a limited number of mutations can result in an almost infinite field of variants. In order to handle this problem he introduced the idea of shifting balance, which is a less rigorous and strict theory, but a more picturesque metaphor.[485] Wright constructed a graphic representation, which he understood as a short and non-mathematical approach to biological evolution resembling a certain similarity with a topographical map. Although he emphasised that references to geography are of secondary importance, the result was a map containing multiple peaks surrounded by circular contours. The map was defined by two axes representing the dimensions along which possible combinations can be arranged. Every combination had a certain value and by connecting the points of equal value contours of peaks and valleys arose.[486] Wright assumed that evolutionary selection could carry the species to the top of the nearest peak, but could not cross valleys that separate the current peak from other, probably higher ones. However, should the species be able to cross valleys then it is not under the exclusive control of natural selection, but of a certain trial-and-error mechanism. An indefinitely large species that lives under constant environmental conditions and is exposed only to natural selection can reach equilibrium by occupying a certain peak. The population either grows through an increase in mutation rate or a decrease in mass selection, or it decreases through the opposite process as depicted in Figures 17/A, and 17/B. In both cases evolutionary selection alone does not seem to be sufficiently strong to push the species towards another and possibly higher peak (from peak D to peak E).[487] Wright assumed that the environment is never static, but changes continuously. The landscape constantly deforms by depressing high places and elevating low ones. According to him, if a species is not extremely specialised and occupies a wide field on the landscape, by moving constantly it could find higher general regions. Such a trial-and-error mechanism can shuffle the species about by means of change without advance in adaptation. As a solution he proposed a large species to be subdivided into many local races that shift continually in a non-adaptive fashion on the landscape as depicted in Figure 17/C. Although this exploratory process could result in a

---

[484] Gleick, James: *Chaos, Making a New Science,* Viking Penguin Inc., 1987, pp. 59-80; Williams, Garnett P.: *Chaos Theory Tamed,* Taylor & Francis, 1997, pp. 229-235; Byrne, David S.: *Complexity Theory and the Social Sciences, An Introduction,* Routledge 1998, pp. 32-33; Alchian p. 217; Boyd (1986), p. 11; Quotation in Clausewitz, p. 698.

[485] Wright, Sewall: *The Roles of Mutation, Inbreeding, Crossbreeding and Selection in Evolution,* Proceedings of the Sixth International Congress of Genetics, 1932, p. 356; Joshi, Amitabh: *The Shifting Balance Theory of Evolution,* Resonance, December 1999, p. 66.

[486] Wright, Sewall: *Surfaces of Selective Value Revisited,* Notes and Comments, The American Naturalist, Volume 131, Number 1, January 1988, pp. 115-116; Later he delivered a mathematical model. See Wright, Sewell: *"Surfaces" of Selective Value,* Proceedings of the National Academy of Sciences USA, 1967, pp. 165-172; Amitabh pp. 67-68.

[487] Wright (1932), pp. 360-362; Wright (1988), p. 117.

decrease of fitness as an immediate effect, this way it would become possible that at least one local race finds a higher peak and pulls the entire species towards this better position. Wright emphasised that a "subdivision of a species into local races provides the most effective mechanism for trial and error in the field of gene combinations."[488]

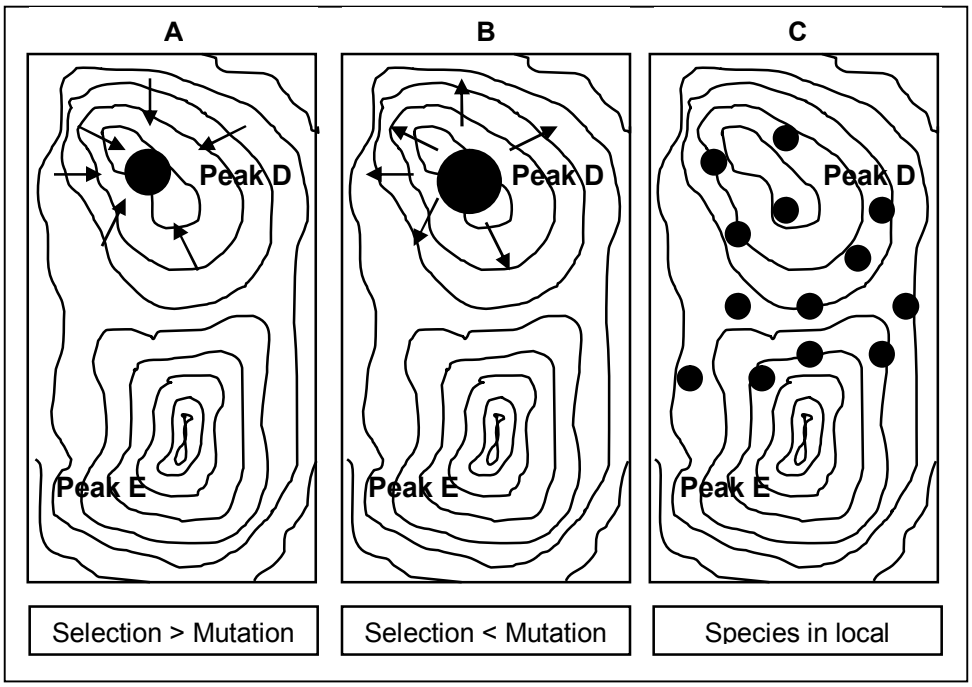

Figure 17: Trial-and-error mechanism by Wright

Thus evolutionary adaptation involves differentiation in which the principal mechanism is essentially non-adaptive. Although he was not explicit, Wright regarded the species themselves as a complex adaptive system that depend on the balance of certain factors controlled by a trial-and-error mechanism. In his attempt to see evolution as a dynamic process he regarded adaptation as a balance between natural selection and random genetic drift with each having a varying contribution to the survival and extinction of species over time and space. He proved that adaptation and chance events play an important role in biological evolution.[489] From a contemporary military point of view, Wright's idea resembles clear similarities with the *network-centric* genre of military writings that are characterised by the following factors:

- The re-focus from the sum of individual platforms to the network of possibilities they provide for, and the gains that can be exploited.
- The re-focus from mostly isolated and homogenous actors to the various interdependencies smaller and more specified players stand for.

[488] Quotation in Wright (1932), p. 363.

[489] Ibid., pp. 362-366; Amitabh, pp. 68-72; Wright (1988), p. 118.

- The re-focus from strategy development in traditional terms to issues such as adaptation, learning and coping under continuously changing conditions.[490]

12.2.1 Applicability Issues

Wright's idea applies to many phenomena in which outputs depend on several inputs. Although he referred to the space of possible *genotypes*, the concept can be extended to model various complex problems ranging from combinatorial chemistry, physics, computer sciences and various social disciplines. It is also very valuable for effects-based operations since no comprehensive list of desired effects can reveal the countless possibilities in which individual effects interact or provide useful information regarding the underlying mechanism.[491] Some critics question the meaningfulness of fitness as a unit of measure and regard the theory a crude metaphor that has heuristic, rather than analytical values. However, they cannot deny that Wright's idea is a fascinating approach towards visualising real-world problems by means of statistical features. In fact, critics acknowledge that despite objections, problems and limitations, a discussion of biological evolution based on the idea of fitness can be helpful. Fitness can reveal insightful guidelines that may be generalisable to more intricate relations of evolutionary mechanisms.[492] In sum, the fitness landscape is a beautiful idea that helps us think about effects-based operations differently by offering the following advantages:

- It helps conceptualise effects-based operations as an emergent and self-organising process.
- It forces us to differentiate better between two basic aspects of adaptation such as efficiency and effectiveness.
- It can give impetus for a different and more sophisticated understanding of strategy development especially in a constantly changing and dynamic environment.
- It can contribute to a meaningful discussion regarding issues such as command and control, and military effectiveness.

Earlier we detailed the way causal relationships develop in war. The suggested biological analogy and the idea of fitness make it possible to see war as a process, which is not always causally connected. They help us see war as a temporal sequence of aggregates rather than a linear process in which earlier events simply cause later ones.[493] Within this framework effects-based operations are conceptualised as a migratory process on an imaginary landscape that

---

[490] Cebrowski, Arthur K. (Vice Adm.)/Garstka, John J.: *Network-Centric Warfare: Its Origins and Future*, Proceedings, January 1998, Internet, accessed 14. 06. 2006, available at www.usni.org/Proceedings/Articles98/PROcebrowski.htm.

[491] Brabazon/Matthews, p. 2; Merry, Uri: *Organizational Strategy on Different Landscapes: A New Science Approach,* Systemic Practice and Action Search, Volume 12, Number 3, 1999, pp. 257-258; Kaufmann (1989a), p. 529; McKelvey, Bill: *Avoiding Complexity Catastrophe in Coevolutionary Pockets: Strategies for Rugged Landscapes,* Organization Science, Volume 10, Number 3, May-June 1999, p. 298.

[492] Gell-Mann, Murray: *The Quark and the Jaguar, Adventures in the Simple and the Complex,* Little Brown and Company, New York, 1994, pp. 247-255; Cruzan, M. B.: *Adaptive Landscapes*, in: Brenner, Sydney/Miller, Jeffrey H: *Encyclopedia of Genetics,* Volume 1, Academic Press, 2001, p. 5; Holland, John H.: *Hidden Order, How Adaptation Builds Complexity,* Helix Books, 1995, pp. 65-80; Mitchell, Sandra D.: *Function, Fitness and Disposition,* Biology and Philosophy, Volume 10, 1995, pp. 47-50.

[493] Matthen, Mohan/Ariew, Andre: *Two Ways of Thinking About Fitness and Natural Selection,* The Journal of Philosophy, February 2002, pp. 79-83.

resembles topographical features. Consequently, the goal is to find and occupy regions that contain high peaks representing high value effects and deny the enemy doing the same.

12.3 General Landscape Features

Backed by computer power Kaufmann and Levin picked-up Wright's idea and stated that evolutionary adaptation is composed of small changes. Its mechanism resembles similarities with a local search process in the form of an *adaptive walk*, which is always constrained. Evolutionary adaptation deals with conflicting requirements that limit the end result. Adaptive walks proceed along a path characterised by fitter variants leading to attainable local or global optima. In other words, both adaptation and fitness come from the environmental context. Real life displays an extended web of relationships and conflicting constraints; therefore they assumed a landscape featuring many peaks and valleys. Kaufmann and Levin regarded adaptation the simplest form of optimisation and also the simplest form of the trial-and-error mechanism. Similar to Wright they saw evolutionary change as a novel and creative process that may or may not be accompanied by adaptation to the constantly changing conditions of the environment.[494]

12.3.1 Uncorrelated Landscapes

As a baseline case they first examined adaptation on uncorrelated fitness landscapes. In such landscapes they suggested to draw the fitness value of each entity randomly from a given, but fixed underlying distribution. Kaufmann and Levin used N genes where each gene could have only two values, 1 standing for gene activated and 0 for not activated. The number of possible combinations is 2^N with 1 being the lowest value and 2^N the highest. Connecting the 2^N points with lines results a landscape-like surface, which is very rich in peaks or local optima. According to them the number of such local optima increases almost exponentially to N resulting that on an uncorrelated landscape the expected lengths of adaptive walks are generally very short. Each successive step on average moves halfway from the current point, towards the point with the maximum value. After each step the expected number of fitter points is halved on average. The result being that the stopping times are distributed very tightly. In such a setting the great majority of *adaptive walks* stop within one or two steps. The number of alternative pathways leading to optima with higher fitness values decreases linearly with the rank order of the points. Consequently, with an adaptive walk from any single starting point via a *1-mutant fitter variant* only a small fraction of the true local optima is accessible.[495] Kaufmann and Levin argued that the success of an adaptive walk depends on the correlation structure of the landscape. A point with an initially low fitness has many fitter neighbours, a point with high fitness has just few and a point that is a local optimum has none. In such a landscape an adaptive walk can branch into many alternatives early in the process, but the number of alternatives slows down as fitness

---

[494] Kaufmann, S. A./Levin, S.: *Towards a General Theory of Adaptive Walks on Rugged Landscapes,* Journal of Theoretical Biology, Issue 128, 1987, pp. 12-15; Kaufmann (1995a), pp. 163-166; Capra, Fritjof: *The Web of Life, A New Scientific Understanding of Living Systems,* Anchor Books Doubleday, 1997, pp. 222-230, 245-254.

[495] Kaufmann (1987), pp. 19-24; Kaufmann (1995a), pp. 167-169.

becomes higher. Their conclusion was that adaptation on an uncorrelated fitness landscape favours branching radiation that slows ultimately to stasis.[496]

12.3.2 Correlated Landscapes

According to Kaufmann and Levin most fitness landscapes are correlated in which points with similar values are closer to each other. The result is that neighbouring points or 1-mutant fitter variants show similar properties. Correlated fitness landscapes can also be rugged and make for *long-jump adaptation* via *J-mutant fitter variants*. In this case the importance of a local optimum disappears since all points become accessible. As a result the correlation structure becomes weaker and weaker, and the number of local optima diminishes. On such landscapes the importance of the expected waiting time increases as jumps sufficiently far represent adaptation that experiences an uncorrelated landscape. Similar to an adaptive walk they assumed that if more than one J-mutant fitter variant is found the fittest is chosen. Thus on average, a single J-mutant fitter variant lies halfway between the least fit and the fittest; therefore the waiting time to find the next fitter variant doubles with each successive step almost independently of the population's size. Adaptation via J-mutant fitter variants is rapid at the beginning, then slows down and after a modest number of steps stasis sets in. Similarly to adaptation via 1-mutant fitter variants branching into alternatives is more common initially, but progressively harder later. Adaptation via J-mutant fitter variants also tends to prefer branching radiation that eventually quiets to stasis.[497] Later Kaufmann assumed that correlated landscapes might exhibit self-similar, fractal-like characteristics resulting that small hills nestle into the sides of larger hills which again nestle into the sides of much larger hills. Consequently, landscapes can be correlated, but rugged. After a jump with a distance shorter than the maximum the species may land on an uncorrelated landscape when measured on a shorter length scale, but on a correlated landscape when measured on a longer length scale.[498]

12.3.3 Evolutionary Landscapes

Using the insights coming from the two baseline landscapes and the two sorts of adaptation, it became possible to derive some generalisations for adaptation on correlated landscapes. They argued that it makes sense to marry the local and global search in adaptation depending on the time scale of the process. Most statistically rugged landscapes are correlated, and adaptation via J-mutant fitter variants may possibly escape the correlation structure, which is not possible with adaptation via 1-mutant fitter variants. Given a randomly chosen point on the landscape with an average fitness, early in the process the population would sample both in the vicinity via 1-mutant fitter variants and further away via J-mutant fitter variants. Since the fitness is average, half of the points sampled will be fitter and half less so. Due to the correlation structure, points sampled nearby will be only slightly fitter, whereas points further away and not constrained by the power of correlation could reveal much higher fitness levels. Early in the process long jumps trying to find J-mutant fitter variants would become dominant and result in a branching radiation. However, as more J-mutant fitter variants are encountered, the chance of finding J-mutant fitter

---

[496] Kaufmann, Stuart A.: *Principles of Adaptation in Complex Systems,* in: Stein, Daniel L. (ed.), 1989b, pp. 619-622; Kaufmann (1987), p. 26.

[497] Kaufmann (1987), pp. 27-29.

[498] Kaufmann (1989a), pp. 572-577; Kaufmann (1995a), pp. 171-175.

variants will be less than finding nearby and only slightly fitter 1-mutant variants. Consequently, in the mid-term adaptation via 1-mutant fitter variants in the form of an adaptive walk or local hill climbing will dominate the process. However, as the process goes towards the peak, the rate of finding 1-mutant fitter variants decreases and the danger of ending up in stasis grows. Therefore in the long term, adaptation via J-mutant fitter variants will again make sense, since only with long jumps is it possible to land in the vicinity of a fitter point that can again be climbed.[499] Although evolution can be understood as a process composed of long jumps and walks uphill, after each long jump and hill climbing the time requirement for finding the J-mutant fitter variant is typically more than double. Consequently, radiation and stasis are inherent features of the evolutionary process. Early in the process many different pathways branch upward. As time passes fewer alternatives can emerge until single lineages get trapped on local optima. As local optima are approached the number of ways leading uphill decreases. On rugged landscapes radiation and stasis are utterly generic. In other words, adaptation stands for branching lineages that surf on a turbulent fitness sea with both divergence and convergence occurring at wave-tops.[500]

12.3.4 NK(C) Landscapes

Although in reality the contours of fitness landscapes remain *unknown*, they can be reconstructed in order to make them *knowable*. Based on the general insights gained above, Kaufmann developed a model, which is defined both by the variable N and another variable K. Thus the two main parameters are the number of genes N, and the average number of epistatic interactions K standing for conflicting constraints within N that profoundly influence the fitness of any combination. Since K can be tuned from zero to a maximum value, it basically defines the ruggedness of the landscape. As K increases, the landscape changes from smooth to very rugged, or from statistically correlated to statistically uncorrelated:[501]

- K=0 means that there are no epistatic interactions, no conflicting constraints and no cross-connections. The structure of the landscape contains only one global optimum, which makes an adaptive walk via 1-mutant fitter variants possible. This landscape is the simplest possible in which all points are on a connected pathway leading to the top. The surface is smooth with neighbouring points having nearly the same fitness value. Thus knowing the fitness value of one point provides significant information about the fitness value of neighbouring points. On such landscapes for very large N the fitness values of 1-mutant fitter variants are very similar. In that case, walk lengths to the global optimum increase linearly with N resulting that the pace of such a walk is very slow. This smooth landscape perfectly reflects the ideal gradualism of evolution as outlined by Darwin.
- K=N-1 means that the amount of conflicting constraints is maximum and each point is affected by all other points. The result is an entirely uncorrelated and extremely rugged fitness landscape. The fitness value of any given point does not give information about the fitness value of neighbouring points. On such landscapes, the number of local optima is very large and the rate of finding better optima via 1-mutant fitter variants decreases at every step. Thus the lengths of adaptive walks to local optima are generally very short and the

---

[499] Kaufmann (1987), pp. 33-35.

[500] Kaufmann (1989a), pp. 577-580.

[501] Kaufmann (1989a), pp. 540-543; Kaufmann (1995a), pp. 169-171; McKelvey, pp. 301-302.

expected time to find a local optimum is proportional to N. Only a small fraction of the local optima is accessible from any given point. As the number of points increases the fitness value of local optima falls towards the average fitness of the space, which limits the force of selection and the success of an adaptive walk. The fitness values of accessible optima become poorer as the peaks themselves decrease.[502]

12.3.5 Landscapes and Recombination

As Kaufmann argued, between the two end-poles there is an infinite variety of potential surfaces. Should K and N increase proportionately, the fitness of accessible optima becomes an ever poorer compromise and hardly better than mere chance. Such landscapes resemble isotropic features as high peaks move apart from each other in the landscape. Consequently, any one area looks roughly as any other area. Good peaks do not exist since it is not possible to climb higher peaks than afforded by the landscape itself. However, if K is small and fixed whilst N increases the landscapes display non-isotropic features and contain special regions in which high peaks cluster. The location of one high optimum gives information about the location of other good local optima. In this case it is reasonable to search for peaks that lie between two higher peaks that contain mutual information about possible good regions of the landscape. Originally the concept of NK landscapes was developed to understand evolutionary migration of *haploid* gene combinations that do not involve sexual recombination, but happen if advantageous point mutations accumulate. However, sexual recombination of *diploid* gene combinations helps improve the mostly myopic search process of an adaptive walk guided only by the local features of the terrain. Although through sexual recombination it becomes possible for a species to get a bird's-eye view on the landscape, in this case success depends on the correlation structure. Consequently, on random landscapes recombination is useless and does not make any sense since it suffers the problems of long-jump adaptation. However, on correlated landscapes in which the highest optima are close to each other and peaks are largest, the location of any given high optimum carries information about other optima. Peaks contain mutual information about the good regions in which recombination can be compared with the effect of repeated long jumps. Thus recombination is a very powerful form of adaptation on very rugged, but correlated fitness landscapes. The only critical requirement is that local optima must carry mutual information about the location of other good or better optima.[503]

12.3.6 Two Sorts of Catastrophes

NK landscapes can have two baseline cases. Whereas the first equals K=0 and indicates an entirely smooth surface, the other equals K=N-1 and stands for an entirely rugged surface.[504] By approaching one of these two end-poles, evolution suffers from two limits of complexity in the form of catastrophes:

- The first extreme refers to K=0 in which the gradient leading to the single optimum is shallow. In this case selection is not always able to hold the population at the peak and can

---

[502] Kaufmann (1989a), pp. 544-547; Kaufmann (1995a), pp. 173-175.

[503] Kaufmann, Stuart: *The Origins of Order: Self-Organization and Selection in Evolution,* Oxford University Press, 1992, pp. 112-120; Kaufmann (1995a), pp. 180-183; Kaufmann (1989a), pp. 583-592; Coveney/Highfield (1995), pp. 227-228.

[504] Kaufmann (1989a), pp. 569, 611.

become too weak compared with mutation. The adapting population cannot stay at the top of the peak, but flows down mostly in the form of quasi-species into the lower regions of the landscape. This phenomenon stands for large mutation rates that lead to a sudden breakdown of stability. Such a case is called the *error catastrophe*.

- The other extreme refers to K=N-1, which indicates a very rugged landscape containing a huge number of peaks. Here, local optima fall towards the mean of the space. Consequently, walks are locked into typical local regions that have an average fitness value. In this case selection affords only poor peaks to be climbed. A shift towards this extreme results in a *complexity catastrophe*.[505]

Given these two limitations, Kaufmann assumed that early in the evolutionary process adaptation occurs on a highly uncorrelated fitness landscape with a subsequent adaptation happening on a rather well-correlated landscape. Adaptation on a correlated landscape means that the rate of finding fitter variants can either stay constant as the fitness increases or decreases slower than on uncorrelated landscapes. In other words, history does matter since "early development locks in."[506]

12.3.7 Coupled Landscapes

In real life species live in niches afforded by other species, with the result that fitness landscapes are not fixed, but evolve due to interactions with other species. As Kaufmann argued, real evolution is a co-evolutionary process that happens on coupled landscapes in which adaptive moves deform the landscapes of respective partners. This implies epistatic interactions between the landscapes themselves, since in reality the fitness of each species depends both on the environment and other species. Consequently, landscapes of co-evolving species show a very dynamic surface that trembles, waves and heaves. In such a situation all bets are off since attempts of one species to improve its own fitness may deform the landscape of the other species to which it is coupled. Although the fitness landscape of any given species is a function of the adaptive moves of other species since they correspond to the changes, it cannot be excluded that certain aspects of fitness might be independent from interactions. In order to catch the essence of co-evolution he introduced two new variables, C and S. Variable C describes the epistatic interactions between the landscapes and represents those external constraints that influence a species' fitness. Increased C shows how the adaptive moves of species deform the landscapes of their partners. Variable S stands for the number of interacting species, hence the number of different fitness landscapes. Thus the variables tune the landscape's ruggedness and also model the richness of external conflicting constraints.[507] Similar to fixed NK landscapes, on co-evolutionary landscapes there are also two end-poles. Whereas the one end-pole is called

---

[505] Kamp, Christen/Bornholdt, Stefan: *Coevolution of Quasispecies: B-Cell Mutation Rates Maximize Viral Error Catastrophes,* Physical Review Letters, Volume 88, Number 6, pp. 068104-1-4; Franz, Silvio/Peliti, Luca: *Error threshold in simple landscapes,* Journal of Physics A: Mathematical and General, Volume 30, Number 13, pp. 4481-4487; Kaufmann (1989a), pp. 552-558, 580-583, 587-592.

[506] Quotation in Kaufmann (1995a), p. 177.

[507] Kaufmann, (1989b), pp. 675-688; Kaufmann (1995a), pp. 215-222; Kaufmann, Stuart A./Johnsen, Sonke: *Co-Evolution to the Edge of Chaos: Coupled Fitness Landscapes, Poised States, and Co-Evolutionary Avalanches,* in: Langton, C. G./Taylor, C./Farmer, J. D./Rasmussen, S.: *Artificial Life II, SFI Studies in the Sciences of Complexity,* Volume X, Addison-Wesley, 1991, pp. 325-369.

evolutionary stable strategy, the other is called *evolutionary unstable strategy* or the Red Queen. In an evolutionary stable strategy each species climbs to a peak that is consistent with the peaks on the other species' fitness landscape. Under this condition the species stop co-evolving because each is better off not changing as long as the others do not change.[508] At the other extreme the species never settle down, but keep chasing peaks forever. Their effort to deform and lower the peaks on the other species' landscape also alters indirectly their own. Consequently, the behaviour lies in the chaotic domain in which the species run ever faster in order to stay in the same place. For cases in between Kaufmann found that species can co-evolve well. The speed at which species move depends on their current fitness and the ruggedness of the respective landscapes. If species are on landscapes of different ruggedness the rate at which they move uphill depends on their joint fitness and landscape ruggedness. When the amount of coupling between the landscapes is high, by increasing the number of conflicting constraints internally, a species can reach equilibrium faster and gain higher fitness.[509] In general Kaufmann concluded that for K>C equilibrium is encountered more rapidly than for K<C where the waiting time can become very long. For co-evolving species K=C is a crude dividing line for the time requirement to encounter equilibrium. In the case K>CxS the co-evolving partners all get to equilibrium rapidly; in the case K<CxS equilibrium can only set in after a long period of time. Thus the fitness in co-evolving systems increases when a species can adjust its K to C with K=CxS being a rough guide.[510]

---

[508] Beckerman, Linda P. Dr.: *The Non-Linear Dynamics of War,* Science and Application Corporation, 1999, Internet, accessed 04. 07. 2003, available at www.belisarius.com/modern_business_strategy/beckerman/non_linear.htm.

[509] Kaufmann (1989b), pp. 689-702; Kaufmann (1995a), pp. 223-225.

[510] Kaufmann/Johnsen (1991), pp. 334-343; Hordijk, Wim/Kauffman, Stuart A.: *Correlation Analysis of Coupled Fitness Landscapes,* Internet, accessed 12. 12. 2006, available at www.lirmm.fr/mab/IMG/pdf/HK-COMPLEX-05.pdf.

13 Introducing the Effects Landscape

13.1 Construction and Considerations

The evolution of species is manifest in their migratory process chasing high peaks and comes as the result of various genetic combinations. An effect (E) can be seen as the function (f) of an action (a) on an object (o) and be depicted in the form of an equation

$$E = f(a,o)$$

In this chapter we show that the equation also makes it possible to conceptualise effects in terms of genotypes, similar to living species. For this reason, first we clarify what the term genotype stands for. The genotype of an organism can be defined as "the class to which that organism belongs as determined by the description of the actual physical material made up of DNA that was passed to the organism by its parents at the organism's conception."[511] In a similar fashion we understand genotype as the specific makeup of an effect that refers to certain composition of objects as outlined in the equation above. However, before we go further it is important to make a distinction between an object and an objective. Whereas in terms of effects an object forms the focus of an action as it sets the boundaries between phenomena, an objective exists only as a specific state regardless of whether an action was taken or not.[512]

13.1.1 The Effect-Genotype

The first part of the equation refers to actions and can be grouped in many ways. Well-known terms such as *divert*, *delay*, *disrupt*, *destroy*, and *demoralise* can describe actions needed to achieve effects as well. Another more comprehensive and extended listing can include *deter*, *destroy*, *disrupt*, *degrade*, *decapitate*, *divert*, *dislocate*, *delay*, *deny*, *deceive* and *defend*.[513] The listings provide us with a vast array of options. However, we suggest a simplification in which an action is limited to two alternative states such as action taken standing for 1 or action not taken standing for 0. The second part of the equation refers to the object and is equivalent to the number of genes N. In a military conflict, similar to living organisms the number of objects that

---

[511] Quotation in Stanford Encyclopedia of Philosophy: *The Genotype/Phenotype Distinction*, Internet, accesed 21. 09. 2006, available at http://plato.stanford.edu/entries/genotype-phenotype.

[512] McCrabb, Maris "Buster" Dr.: *Explaining "Effects": A Theory for an Effects-Based Approach To Planning, Executing and Assessing Operations,* Version 2.0, as of 07. 08. 2001, pp. 7-12, Internet, accessed 08. 03. 2005, available at www.dtic.mil/jointvision/ideas_concepts/ebo.doc; Jobbagy, Zoltan (Maj.): *Wars, Waves and the West. Putting Effects-Based Operations into Context,* TNO FEL-04-B-077, May 2005, p. 54; Vego, Milan N.: *The Problem of Common Terminology*, Joint Force Quarterly, Issue 43, 4th Quarter 2006, p. 45.

[513] Walker, Scott G. (Maj.*): Targeting for Effect, Analytical Framework for Counterland Operations*, School of Advanced Airpower Studies, Air University Press, Maxwell AFB, May 1998, pp. 28, 73; McCrabb, Maris "Buster" Dr.*: Concept of Operations For Effects-based Operations*, Draft, Version 2.0, Air Force Research Laboratory, 2002a, p. 11, Internet, accessed 03. 03. 2003, available at www.eps.gov/EPSdata/USAF/Synopses/1142/Reference-Number-PRDA-00-06-IKFPA/Latest_EBOCONOPS.doc; Wagenhals, Lee W./Levis, Alexander H.: *Effects based course of action analysis in support of war games*, Internet, accessed 18. 03. 2003, available at www.mors.org/meetings/ebo/ebo-reads/Wagenhals_Lewis.pdf.

must be considered is normally very large.[514] Thus each effect has genes represented by bits composed of binary numbers. Pairing objects with actions means that an object can either be targeted in the form of action taken or not targeted in the form of action not taken. Consequently, the effect-genotype represents a given combination of effects and takes the simple form of a binary string with 2^N possibilities.[515] For example in the case of ten objects (N=10) and the two sorts of actions the effect-genotypes can have 2^{10} or 1024 various possible states ranging from 0000000000 to 1111111111. These possibilities can be depicted in the form of a landscape that contains various peaks representing the different values of the effect-genotypes. Similar to Kaufmann's NK model we define the value of any combination as the average of the contribution of the individual objects, each in its own context and the K other objects in the form of functional couplings or epistatic interactions. The effects landscape is defined by effect-genotypes consisting of a given number (N) of objects (o) with two possible states at each object (o_i) and can be expressed as follows

$$F(o) = \frac{1}{n}\sum_{i=1}^{n} F_i^{(\alpha)}(O_{1i}, O_{i1}, O_{i2}, O_{i3}, ...O_{ik})$$

Whereas for K=0 each object is independent of all other objects, for K=N-1 each object depends upon itself and all other objects. Thus each object's fitness contribution depends on the choice between the two different binary states at each of the K other objects that impinge upon it.[516] The effects landscape reminds us that effects are highly complex phenomena. There is no single dimension along which it becomes possible to search and find combinations that possess good or high value. Hence predefining desired effects often do not make sense. Effects-based operations represent a high-dimensional search process that aims at finding an optimum combination of effects with the goal to occupy high spots on the landscape in which a given combination of effects influences battlefield performance and as a consequence the outcome of war.[517]

---

[514] According to Kaufmann an organism such as the eukaryote has 20,000-100,000 structural genes and a variety of other control points. See Kaufmann (1992), p. 427; In order to interdict enemy ground units the Air Campaign during Operation Iraqi Freedom identified and struck approximately 19,900 aim points or objects. See Conetta, Carl: *Catastrophic Interdiction: Air Power and the Collapse of the Iraqi Field Army in the 2003 War,* p. 2, Internet, accessed 07. 03. 2005, available at www.comw.org/pda/fulltext/0309bm30.pdf.

[515] Rinaldi, Steven M. (Maj.): *Beyond the Industrial Web, Economic Synergies and Targeting Methodologies,* School of Advanced Airpower Studies, Air University Press, Maxwell AFB, April 1995, p. 53; Kaufmann (1989a), p. 540; Levinthal, Daniel A.: *Adaptation on Rugged Landscapes,* Management Science, Volume 43, Number 7, July 1997, pp. 936-937; Ramsey, Marshall: *GA Optimizer*, Artificial Intelligence Lab, The University of Arizona, Internet, accessed 21. 11. 2006, available at http://ai.bpa.arizona.edu/~mramsey/ga.html.

[516] Kaufmann, Stuart A./Macready, William G.: *Technological Evolution and Adaptive Organisations, Ideas from biology may find applications in economics,* Complexity, 1995b, p. 28; Levinthal, pp. 936-937; Hordijk, Wim: *Population Flow on Fitness Landscapes,* Erasmus University Rotterdam, August 1994, pp. 10-11; Altenberg, Lee: *NK Fitness Landscapes,* in: Back T./Fogel D./Michalewicz Z.*: The Handbook of Evolutionary Computation,* Oxford University Press, 1997, section B2.7.2, p. 2; Goertzel, Ben: *From Complexity to Creativity Computational Models of Evolutionary, Autopoietic and Cognitive Dynamics,* Internet, accessed 11. 12. 2006, available at http://goertzel.org/books/complex/contents.html.

[517] Rivkin, Jan W.: *Imitation of Complex Strategies,* Management Science, Volume 46, Number 6, June 2000, p. 827; Ilachinski (1996b), pp. 136-137.

13.1.2 Context Dependency and Limitations

Before we go on detailing the implications of such a conceptualisation of war some limitations must be acknowledged. Despite similarities with Kaufmann's model we understand the effects landscape in heuristic terms and do not attempt to quantify the search process more precisely. Consequently, we acknowledge that it might not always be possible to find a search process that guarantees a good optimum, and similar to biological evolution in war we have to accept mostly sub-optimal solutions. Whereas in the NK model the search process is driven by an algorithm that always chooses the fittest option, it is not always possible to do that in reality. Much of real-life problems are NP complete and intractable to analytical solutions in the form of algorithms.[518] A further limitation is due to the fact that cultural imprints and past experience always distort perception. For example the same phenomenon or even a simple symbol can have a different meaning for a Christian and a Muslim. Reality is not directly comprehensible and the effects landscape represents a specific mapping of reality. Identity can limit the search process by excluding certain areas that may contain good peaks, but cannot be explored or climbed. Due to these blinders, the effects landscape is always a compressed and distorted form of reality that puts limitation on the search potential. A further reason why the search process is suboptimal comes from the fact that it is not the peaks sought, but the landscape's ruggedness that determines the success of any given search. The effects landscape exists only in our representation, which means that the search process is typically constrained and appears mostly in the form of a biased walk. In other words, the effects landscape has no objective reality separable from the autonomous agents inhibiting it. Although this sort of bias sometimes eases the search process, it always limits the search potential. Thus any problem decomposition in the form of an effects landscape only coincides with the reality as it "may or may not correspond to the 'true' decomposition structure".[519] An utterly false representation can induce additional and lasting interactions, which influence the way alternatives are generated and evaluated. Consequently, effects landscapes refer to unique and private mappings of the actors involved.[520] This however, indicates that there will never be perfect battle-space knowledge or transparent battlefield available, only approximations with a certain error value. Due to such less-than-perfect descriptions generating wrong predictions, as time passes the desired peaks on the landscape might differ from the expected peaks, which again might differ from the actual peaks found. We must always assume that very good strategies might often become hidden for long periods of time, but can also emerge occasionally.[521]

---

[518] Weinberger, Ed: *Correlated and Uncorrelated Fitness Landscapes and How to Tell the Difference,* Biological Cybernetics, Volume 63, 1990, p. 326; More on NP-completeness see Rivkin, pp. 826, 831-832.

[519] Brabazon/Matthews, pp. 6-18; Beckerman; Smith (2006), pp. 142-148; Dosi, Giovanni/Levinthal, Daniel A./Marengo, Luigi: *Bridging contested terrain: linking incentive-based and learning perspectives on organisational evolution,* Industrial and Corporate Change, Volume 12, Number 2, 2003, pp. 418-422 (quotation p. 418).

[520] Roos, Johan/Oliver, David: *From Fitness Landscapes to Knowledge Landscapes,* Systemic Practice and Action Research, June 1999, p. 284.

[521] Sakulich, Timothy J. (Lt. Col.): *Precision Engagement at the Strategic Level of War: Guiding Promise or Wishful Thinking,* Occasional Paper No. 25, Center for Strategy and Technology, Air War College Maxwell AFB, December 2001, pp. 15-18; Daven, Choy (Capt.): *Effects-Based Operations: Obstacles and Opportunities,* Journal of the Singapore Armed Forces, Volume 30, Number 2, 2004, Internet, accessed 31. 08. 2004, available at http://www.mindef.gov.sg/safti/pointer/back/journals/2004/

13.1.3 Further Considerations

Whereas war exists in a high-dimensional space, the effects landscape can only provide us with certain statistical characterizations of the space of possibilities. Thus the search space is explored in one particular direction, which always implies biased characterisation of the landscape. The way effects are constructed also does not provide clear and attainable information on the genotype/phenotype mapping. The way effects are generated and perceived can differ significantly. Despite its power to deliver helpful and valid statistical insights regarding the possibility space, the predictive power of the effects landscape is limited. The effect-genotype has more to do with landscape statistics than landscape reality. It allows for analysing the search space only along a single fitness function and if the problem is multi-objective it cannot provide for further and broader generalisations. Despite all its utility, even the effects landscape is unable to capture the true nature of emergence with all its self-organising attributes.[522] Nevertheless, the effects landscape is a powerful aid in conceptualising war in a novel way. Effects-based operations are seen as a process that rests on adaptation and mutation in which we attempt to offset changing conditions coming both from the environment and interaction with the enemy. Conceptualising effects-based operations this way also has the advantage that the emerging search process can be defined by the network of effects and not exclusively by desired effects. Regardless of the approach and methodology chosen it will never be possible to explore the vast space of possibilities. However, the effects landscape can give us a chance of understanding the complexity of war and framing it as a complex optimisation problem that includes approximations and estimations regarding optimal values. The effects landscape can also give us a chance to assess the benefits of further optimisation or to define termination criteria.[523] The effects landscape reminds us that it is often more important to gain insight into the mechanism of how effects interrelate rather than to define desired effects. The frictional, chaotic and complex reality of war indicates that the combination of effects often counts more than desired individual effects.

13.2 Dissecting Adaptation

Conceptualising war and effects-based operations in the framework of a complex adaptive system requires the ability to manage polarities rather than solving problems. Evolution comes as the result of two search mechanisms such as adaptation via 1-mutant fitter variant and J-mutant fitter variant. In a similar fashion in the framework of the effects landscape, effects-based operations can be seen as a combination of two different, but interrelated processes such as being *effective* and *efficient*. We made it clear earlier that although in normal English usage both refer to effects, there is a significant difference between them:

- *Effectiveness* – stands for the quality of being able to achieve an effect or the ability of becoming effective. It has a general meaning since it describes only the power to carry out

---

Vol30_2/3.htm; Beinhocker, Eric D.: *Robust Adaptive Strategies,* MIT Sloan Management Review, Spring 1999a, pp. 98-99; Rivkin, p. 833.

[522] Teo, Jason T. W.: *Pareto Multi-objective Evolution of Legged Embodied Organisms,* University of New South Wales – Australian Defence Force Academy, Ph. D. Thesis, 2003, pp. 84-85.

[523] Rosé, Helge: *Complexity of Fitness Landscapes,* Proceeding, International Conference on Complex Systems, Noshua, USA, 21-26. 09. 1997, Internet, accessed 11. 08. 2005, available at www.first.fraunhofer.de/publikationen?prID=1167&von=mitarbeiter.

an act that has a certain result. Effectiveness suggests the accomplishment of a desired result especially as viewed after the fact.

- *Efficiency* – stands for the capacity to produce a certain desired result with a minimum expenditure of resources. It has a more specific meaning and describes the suitability of a given procedure. Thus efficiency stands for being the immediate agent in producing an effect. It suggests an action or a potential for an action in such a way as to avoid loss or waste of energy in producing a result.[524]

The biggest difference between the two is that whereas effective stands for the power to produce an effect, efficient describes the process of producing an effect. The following simple comparison may explain the fundamental difference between the two:[525]

$$\textbf{Effectiveness} = \frac{\textit{Realised Output}}{\textit{Desired Output}}$$

$$\textbf{Efficiency} = \frac{\textit{Realised Output}}{\textit{(Desired) Input}}$$

In the framework of the equations above, effectiveness gives information about what kind of end-state is achieved and forces us to think more precisely about what we want to achieve. Efficiency can be regarded as the relation between input and output, representing how the end-state is achieved.

13.2.1 Effectiveness and Efficiency

The difference between effectiveness and efficiency can be conceptualised in the framework of the proposed imaginary landscape. Whereas efficiency means climbing discovered peaks and is analogous with adaptation via 1-mutant fitter variants, effectiveness stands for searching for good peaks and is analogous with adaptation via J-mutant fitter variants. Consequently, efficiency stands for exploiting or making incremental improvements in the form of adaptive walks. Effectiveness stands for exploring new areas in order to detect opportunities as a result of long jumps that can be exploited. Climbing peaks in the effects landscape can be understood as increasing efficiency, exploring new and potentially high peaks as an attempt to increase effectiveness. Searching for efficiency means a process of climbing higher on a discovered hill until the peak representing maximum effect is reached. Being on the top indicates that we have achieved an effect with the minimum use of resources. Efficiency presupposes that the hill has a clearly defined and hardly changing shape, which makes both path and peak visible. Efficiency contains a high degree of certainty and predictability with the chance to define desired effects and develop plans to realise them. Efficiency allows for a classical problem solving approach in which we know both where we are relative to the peak, and know how to get to it. Exploiting a peak means doing things the right way or doing things better. Once a peak is climbed it makes

---

[524] Gove, p. 725.

[525] Snowden D.: *Being efficient does not always mean being effective, a new perspective on cultural issues in organisations*, Internet, accessed 21. 11. 2006, available at www.cognitive-edge.com/ceresources/articles/42_new_perspective_on_culture_final.pdf, p. 3.

sense to stay there since it represents a potential function that can be exploited.[526] However, the surface of the effects landscape always changes, which demands a constant discovery of new and higher peaks. Due to the inherent dynamics there is always chance that a peak can become a valley and a valley a peak. Although there might be some correlation between nearby peaks, it is often very difficult to see the contours of the landscape. Uncertainty and unpredictability dominate as the landscape turns increasingly complex. These features require a reorientation based on effectiveness and flexibility, which shift the premium towards searching and discovering new peaks. Being effective means doing better things, which often includes being efficient since the effects landscape contains many different peaks that may offer the potential for climbing uphill. Whereas efficiency means climbing, improving and doing things better, effectiveness stands for searching, exploring and being innovative. In a rough and constantly changing effects landscape one specific approach can become disadvantageous regardless of how excellent the planning and execution. Flexibility and adaptive ability offer more potential since they indicate the importance of learning and innovative skills. Effectiveness emphasises possibilities rather than prediction and point towards compromise solutions that make it possible to address the conflicting constraints of various sub-problems since rugged landscapes contain many more low than high peaks.[527]

13.2.2 Parallel Processes

As the imaginary landscape indicates we should become able to find a balance between exploration and exploitation. Exploration to the exclusion of exploitation represents experimentation with alternatives that involve uncertainty and distance, but no potential for gaining benefits. Exploitation to the exclusion of exploration represents refinement and is mostly associated with being proximate and predictable. However, the peaks we try to climb might easily be poor local optima. Whereas efficiency in the form of exploitation represents an internally focused approach, effectiveness stands for an external focus and new connections that allow for a "jump clear across the landscape to a new distant hill."[528] In general, efficiency and effectiveness are interconnected phenomena and mean that the emphasis should rely less on reducing environmental uncertainty or simply waiting for structural inertia and more on appreciating the power of simultaneous selection and adaptation. Thus efficiency and effectiveness are not mutually exclusive alternatives that can be treated only within their own domain of applicability, but fundamentally interdependent. Consequently, they are not conflicting perspectives or complementary views, but two interrelated processes of change.[529]

---

[526] Merry, Uri: *Organizational Strategy on Different Landscapes: A New Science Approach,* Systemic Practice and Action Search, Volume 12, Number 3, 1999, pp. 257-259; Kaufmann (1995b), p. 222; Kaufmann (1989b), p. 625.

[527] Merry, pp. 260-262.

[528] March, James G.: *Exploration and Exploitation in Organizational Learning,* Organization Science, Volume 2, Number 1, February 1991, pp. 71-73, 85; Quotation in Beckerman; Meyer, Christopher: *Survival Under Stress,* MIT Sloan Management Review, Fall 2002, p. 96.

[529] Roos/Oliver, p. 289; Levinthal, Daniel A.: *Organizational Adaptation and Environmental Selection – Interrelated Processes of Change,* Organization Science, Volume 2, Number 1, February 1991, pp. 140-145; Courtney, Hugh: *Making the Most of Uncertainty,* The McKinsley Quarterly, Internet, accessed 22. 03. 2005, available at http://www.mckinseyquarterly.com/article_abstract.aspx?ar=1128&L2=21&L3=37&srid=10&gp=1.

13.3 General Topography

The central element in our metaphor is fitness, which describes the relative value of a certain effect-genotype. Before we detail the consequences of the effects landscape it is important to compare Wright's original shifting balance theory with Kaufmann's NK model. The original theory is rather static as it emphasises the importance of height difference between peaks, assumes subdivision of a species into local races that move around in a non-adaptive fashion either to find higher peaks or just to be in the right place by chance in case the environment changes. Climbing is the only form of moving uphill and attention is paid exclusively to environmental changes as the major reason for topographical consequences. In other words, the importance of time is not of first consideration. For Kaufmann both the height differences between peaks are important, and the way those peaks are located in the landscape is a result of various internal and external conflicting constraints. His model also allows for the possibility of jumping long distances in the landscape in order to escape the correlation strength. Furthermore, he assumes that given an average fitness both the number of steps and the time requirement needed to find a higher position increase after each subsequent step. Thus time plays an important role since the process of evolution is examined in more detail. It is faster in the beginning, but eventually slows down. In general Kaufmann regards fitness as a function of various more or less favourable environmental changes and a dynamic co-evolutionary process.

13.3.1 Different Regions

The space of possibilities in the effects landscape is N-dimensional. For a better understanding we suggest to imagine a large two-dimensional grid in which N defines the size. Each grid represents a certain effect-genotype with a given value. The topographical features of a landscape arise when heights of nearby grids are connected that turn the two-dimensional sheet into a mountainous three-dimensional landscape.[530] Due to differences in their respective values, the effect-genotypes emerge in the form of hills and valleys of various sizes and shapes. The surface of an effects landscape can range from entirely correlated to entirely uncorrelated resulting in a smooth or rugged surface. Between these two extremes there are landscapes that are correlated, but rugged. The way topographical features are located is influenced by the interactions and coupling of the constituents that refer to epistasis or conflicting constraints as outlined by Kaufmann. Thus equilibrium expressed in K=0 and chaos in K=N-1 form the two end-poles within which effects landscapes exist. Consequently, most effects landscapes are rugged, but correlated. They display many peaks of various heights even in the form of peaks within peaks indicating that effects landscapes contain many more low peaks than higher ones.[531] Similar to biological evolution, in the framework of the effects landscape it is impossible to predict when transitions will occur or what the resulting pattern in terms of peaks will be. However, effect-genotypes with similar values might often be close to each other and as a simple analogy we suggest a subdivision into three different regions:

---

[530] Beinhocker (1999a), p. 98; Beinhocker, Eric D.: *On the Origins of Strategies,* The McKinsey Quarterly, Number 4, 1999b, p. 50; Rivkin, p. 827.

[531] Waldrop, pp. 102-105; Kauffman (1991), pp. 64-67; Merry (1999), p. 265.

- *Low* – the first region is equivalent to physical effects. This region contains only peaks of low heights in the form of hills that can easily be climbed. It indicates a simple foresight horizon that comes as a result of tightly linear attributes.
- *Medium* – the second region is more mountainous and refers to systemic effects. This region stands for a complicated/complex foresight horizon that comes as a result of loosely linear and loosely complex attributes.
- *High* – the third region is equivalent to psychological effects. It is the most multi-peaked region indicating a chaotic foresight horizon that comes as a result of tightly complex attributes.[532]

A further important aspect of the effects landscape is the frequency with which the surface changes. In general we can say that the surface of lower regions change more often and dynamically than that of higher regions, as it is relatively easy both to achieve and compensate for physical effects. The higher the region, the more static is the surface. Although low peaks can be discovered with relative ease, the peaks themselves have a low value. Unfortunately, higher peaks are not only more difficult to find as they are scattered over the landscape in relatively small regions, but also most paths leading to the top remain hidden. This characteristic explains why it is more difficult to achieve psychological than physical effects and why psychological effects have a longer temporal horizon indicating *strategic* value. Even successful exploration of a given region does not yield information regarding where to search further. Thus the exploration of one region does not always give sufficient knowledge on other and preferably higher regions. The only certainty is that moving from the lower regions of the landscape to higher ones has the consequence that the higher the peaks the higher the possibility that they offer only potential value.[533]

13.3.2 Effects as Peaks

The effect-genotypes indicate effects-based operations as a search process on an imaginary landscape. The number of objects N can be very large, the result being that the length of an effect-genotype can be enormous with values ranging from 1 to 2^N. Earlier we made it clear that effects are located on a continuum characterised by physical and psychological effects as end-poles.[534] Thus as we move from physical towards psychological effects their value increases, which explains effects-based operations as a process that chases high peaks on the effects landscape. However, we must take equally into account that the more we move towards psychological effects, the more complex they become as both the amount of objects involved and the number of conflicting constraints increase. In other words, the average height of the peaks we encounter might be lower than expected:

- A simple physical effect such as destroying a tank, an airplane or a bunker does not include many conflicting constraints that must be taken into account.
- A systemic effect such as shutting down a power plant in a given area can have the consequence that the enemy cannot operate his military arsenal properly. However,

---

[532] Maxfield, Robert R.: *Complexity and Organization Management,* in: Alberts/Czerwinski.

[533] Roos/Oliver, p. 284.

[534] Jobbagy (May 2005), pp. 55-57.

hospitals or critical water supply facilities may also suffer a shortage in energy thus causing innocent civilians to starve and die.

- A psychological effect can suffer from even more conflicting constraints that may run through various ethnic, religious, social and political dividing lines in any given society. As the example in Iraq shows the population is mostly Muslim, but the non-Arabic Kurdish minority makes up a large part of its territory and lives in a separated region in the North. Political and religious differences between the two ethnically Arab groups of Shi'as and Sunnis are also large.[535]

As we move from physical towards psychological effects the landscape turns increasingly rugged containing many uncorrelated peaks that often jeopardise a successful search process and decrease the prospect of finding good peaks. Thus there are certain common sense elements that must always be taken into account when conceptualising effects-based operations.[536] Instead of focusing exclusively on the upper right area of the continuum of war we propose reconsideration in terms of the *probable*. This can help us find the ideal mixture of available means and achievable ends. The more we adhere to what is probable the better we can combine effectiveness and efficiency. Although this means that we lower our ambition in terms of desired effects, we can take better advantage of available means and address the often proposed coherency of effects. Thus we sacrifice focus in order to gain flexibility. However, then the question arises naturally: why is achieving psychological effects in effects-based operations understood as something more desirable than achieving physical or systemic effects? Even John Warden, one of the founding fathers of the concept, suggested the opposite by arguing that we should focus more on the physical side of the enemy.[537] In terms of the effects landscape two processes explain this phenomenon. Although on average the value of local peaks declines slightly with K, the number of such peaks increases. Thus moving into the more rugged regions of the landscape has the consequence that the number of true local optima decreases, but their value increases with the result that "the expected value of the maximum fitness level increases".[538] In such a landscape it is very difficult to find high value effects since the area from which to start is essentially smaller. Approaching effects-based operations from the psychological end-pole has the consequence that the effects landscape becomes very rugged in which high peaks spread apart, and even if one is detected its location carries only a very limited amount of information regarding the location of other high peaks. Due to their distance peaks often represent different and unrelated psychological effects rather than variations.[539] Effects-based operations are mainly associated with psychological effects aimed at creating a behavioural change in the enemy despite the fact that such effects are generally very difficult to

---

[535] Central Intelligence Agency: *The World Fact Book 2004,* Internet, accessed 08. 03. 2004, available at www.cia.gov/cia/publications/factbook/geos/iz.html#People.

[536] Davis, p. 21.

[537] Jobbagy, Zoltan (Maj.): *Powered Flight, Strategic Bombing, and Military Coercion: Study on the Origins of Effects-Based Operations,* TNO Report, Clingendael Centre for Strategic Studies, CCSS-05-006, November 2005, pp. 46-48.

[538] Levinthal, pp. 942-943 (quotation p. 943); Kaufmann (1989b), p. 546.

[539] USJFCOM JED: *The Multinational Effects-Based Operations Process (CONOPS),* Version 0.65, 7 January 2005, pp. 3-4, Internet, accessed 04. 03. 2005, available at www.act.nato.int/events/seminars/05mne4etodevloews1.htm; Rivkin (2000), pp. 834, 838.

achieve. It appears that we intentionally focus on the assumed height of the maximum peak rather than on the landscape's ruggedness, which profoundly influences the topographical features. Obviously waging war and mountaineering practices share at least one common element. Both soldiers and alpinists are equally enthusiastic about finding and climbing the highest possible peak. In their effort to reach new heights they often disregard reality in terms of what can and cannot be achieved.

13.4 Other Features

The surface of the effects landscape is not fixed, but coupled to the effects landscape of the enemy. The way effects landscapes are coupled bears consequences for possible catastrophes mostly in the form of long, protracted and indecisive campaigns based on attrition and annihilation. The only thing possible in such cases is to decouple the landscapes as shown by the American example in Vietnam and the Soviet experience in Afghanistan.

13.4.1 Coupling and Catastrophes

According to Kaufmann in the case of coupled landscapes the fitness of co-evolving species becomes higher when they are able to adjust their conflicting constraints to the level of their external couplings. Thus K=C was regarded as a rough dividing line for the time needed to achieve mutual equilibrium. In a similar fashion war can be understood as a contest between two belligerents in which each wants to maximise survival chances by forcing the other into regions of lower fitness. The course of war proceeds from an evolutionary stable situation towards an evolutionary unstable state as the belligerents act, react, and interact. Based on Hobbes discussion of war, the temporal aspect can be seen as the very enabler of other advantages such as limited casualty, destruction and low cost. Consequently, it suggests that we should go back as fast as possible to another and more preferable stable situation. Only this way is it possible to achieve a better state of peace in the form of a new equilibrium since as war unfolds the chance to be dragged into a Red Queen race grows. However, if we can control our internal couplings and achieve a rough K=C situation faster, our chance of victory grows. Raising K above C temporarily means gaining flexibility. Although this goes together with an increase of conflicting constraints, only this way becomes possible to induce a multitude of options that can be exploited. We must take into account that it is not possible to entirely harmonise internal and external couplings, but this sort of parallelism enables us to become as rugged as the environment. The overall result is that the complexity profile internally mirrors the external complexity, which resembles similarity with Ashby's law of requisite variety. In other words, we become able to track and climb those peaks that offer the best effects and come as a result of dynamic and constantly changing interactions with the enemy. The frictional, chaotic and complex reality of war demands that we maximise our internal diversity so as to be optimally prepared for any foreseeable or unforeseeable contingency, which comes from the interplay with an intelligent enemy.[540] Ashby's law indicates that if we can find the narrow edge of chaos, it becomes possible to push the enemy towards one of the two end-poles. Should not we find this

[540] Beinhocker (1999a), p. 100; Ashby, Ross W.: *An Introduction to Cybernetics,* Chapman & Hall Ltd., 1957, pp. 202-218; Beinhocker (1999a), p. 105; Pascale, Richard T.: *Surfing the Edge of Chaos,* MIT Sloan Management Review, Spring 2003, p. 86; Markides, Constantinos C.: *A Dynamic View of Strategy*, MIT Sloan Management Review, Spring 1999, p. 62.

area, there is a chance that we drift either towards panaceas believing that through simple destruction we can generate desired psychological effects, or towards attrition and annihilation in which regardless of the means applied we achieve mostly scattered physical effects. In semantic terms both options are *effects-based*, but the effects achieved are less than optimal. The recent history of warfare is rich in examples of this kind. Most strategic bombing campaigns of World War II point towards the former, the trenches of World War I represent the latter. However, we should not forget that even if we can act within the area of the possible no-one can ever "reach maximal fitness, only relative fitness, taking into account the other".[541] Co-evolution tells us that as time passes competitive advantages always tend to diminish. If the opponent is pushed towards K=0 he becomes paralysed and cannot adapt to changing circumstances. He is unable to react properly since the pace of change is quicker than his ability to adapt successfully. In his effort to offset the growing disadvantage, he constantly mutates and can probably achieve lower level physical effects, but does not possess the ability to capitalise on any sort of synergy among them. Thus he achieves some sort of pseudo-effects as a result of destruction. His actions can inflict damage by sporadically killing friendly forces personnel or destroying friendly assets, but these activities cannot spill over into coherent operations. Although such effects can be distributed uniformly over the space, his situation represents the error catastrophe. The enemy climbs desperately uphill without realising that the peak he occupies has already started to shrink. Instead of exploring new alternatives he clings either to a particular region or a hill thus getting the false impression of potential success.[542] The other extreme is when the enemy is driven towards a chaotic situation K=N-1 and gets dragged so deep into the conflict that the effects he achieves suffer from an increasing amount of conflicting constraints. In this case complexity catastrophe sets in. He is not able to take hold of the peaks explored, but wanders around the landscape desperately chasing high peaks. Due to the amount of conflicting constraints the effects he achieves instantly reduce the potential and value of other effects. Thus he constantly explores the landscape without finding exploitable peaks. Consequently, he suffers only a loss and not a gain in fitness.

13.4.2 Recombination and Occupation

A further interesting feature of the effects landscape is the issue of recombination as it became clear that in evolutionary terms diploid organisms offer more potential for finding new peaks on correlated landscapes. Sexual recombination is equivalent to many long jumps and provides an aerial view of the landscape. Thus the question regarding recombination in effects-based operations arises naturally. In biological organisms the issue of sex is an implicit part of the fitness function, whereas in effects-based operations it is explicit.[543] As outlined earlier, one assumed advantage of effects-based operations is that the concept relies on the parallel application of all elements of national power including diplomatic, informational, military and economic efforts.[544] By capitalising on the power of these four elements we can lift our position

---

[541] Quotation in Merry, p. 272; Beinhocker, Eric D.: *Strategy at the Edge of Chaos,* The McKinsey Quarterly, Number 1, 1997, p. 35, Arthur, Brian W.: *Competing Technologies, Increasing Returns, and Lock-in by Historical Events,* The Economic Journal, March 1989, p. 116.

[542] Franz/Peliti, p. 4481; Merry, p. 261.

[543] Hordijk, p. 7.

[544] Jobbagy (May 2005), p. 51.

from which the effects landscape can be observed, and find better regions which offset the typical shortcomings of long jumps. Recombination as manifest in a comprehensive approach makes it possible to jump farther away and reduces the time requirement of finding high value effects. Unfortunately, similar to biological evolution, if the effects landscape is very rugged also recombination in the form of integrating all elements of national power suffers from serious limitations. Another no less important issue concerns whether we should stay or move once a peak is occupied. In Wright's original landscape the species moved in a non-adaptive fashion subdivided into many local races that nested around a given peak. They detected new peaks either by chance or just happened to be at the right spot when the environment changed. In either case, through cross-breeding the lucky genotype pulled the entire species uphill. Kaufmann's model allows for a much more dynamic process that rests both on adaptation via 1-mutant fitter variants or adaptation proper in a Darwinian sense, and on adaptation via J-mutant fitter variants. The question of moving or staying on a peak in the effects landscape depends on the fitness difference between the potential of the effect that can be exploited and the dynamics that can suppress or elevate the peak already explored. Due to the unpredictability of war it makes sense to stick to, and exploit peaks already found, which seems to be a good hedge against possible unsuccessful jumps. Such a pre-cautionary measure is even more important, as a long-jump adaptation means that only one peak is examined out of a large pool of possibilities. Since the evaluation of distant peaks is always difficult and equals a real value plus an error term, sticking to peaks already achieved can be a good measure if the landscape changes.[545]

13.5 Conclusion Part II

This part of the thesis proved the assumption that "biological perspectives on human behaviour have much to offer in the search for a better understanding of conflict and war."[546] Regardless whether we see war through the eyes of Clausewitz, approach it as a complex adaptive system, or examine it along attributes that display similarities with biological evolution, we find timeless and innate characteristics. War stands for primordial violence: it is intrinsically complex, which comes as the clash of physical and psychological forces.[547] In the framework of biological evolution we treated war as complex adaptive system in which its system properties emerge from the interactions of the many components on lower levels. War contains an abundance of dispersed interactions. Its mechanism lacks global controller, but feeds from cross-cutting hierarchical interactions. It features perpetual novelty and far from equilibrium dynamics that demand continual adaptation. Thus similar to biological evolution, war's composition changes constantly. The co-evolution of the belligerents means that the components feed back and "affect their further dynamics by changing the attributes of the players." [548] War and biological evolution are as much about selection as about transformation; therefore adaptation appears to

---

[545] Levinthal, p. 947.

[546] Quotation in Goldstein, Joshua A.: *The Emperor's New Genes: Sociobiology and War*, International Studies Quarterly, Issue 31, 1987, p. 33.

[547] Speech by Chief of the Army Lt. General P. F. Leahy at Conference held at the National Convention Centre in Canberra on 22 September 2005, Internet, accessed on 29. 04. 2008, available at http://www.defence.gov.au/army/pubs/CAspeeches/20050922_1.pdf.

[548] Levin, Simon A.: *Ecosystems and the Biosphere as Complex Adaptive Systems*, Ecosystems, Number 1, 1998, pp. 431-434 (quotation p. 434).

be at the heart of both. Transformation emphasises the *process character* of war. It stands for the importance of not only how to respond to perturbations properly, but also how to maintain the capacity to respond adaptively.[549] The complexity inherent in war and biological evolution can be modelled in similar ways. Although the attributes of the underlying mechanisms of the similarity is obvious, we should bear in mind that the approach we took can only give insights, but never definite answers. Despite the underlying mathematics, the effects landscape is rather qualitative and descriptive in nature as it guides our thinking increasingly towards "adaptation, evolution, behaviour, metaphors, and models".[550] Certainly, from a biological point of view war can be seen as a struggle for existence in which victory stands for survival of the fittest. However, unlike in the case of the exact natural sciences there is no biological law of nature and war cannot be expressed as a mathematical function of its variables. This was the very reason for introducing the Organic Strategic Ecosystem metaphor in order to discuss the mechanism of war and its restricting influence on causal assumptions. This way it became possible for us both to grasp the complex web of relations inherent in war and see it as an interdependent whole.[551] Darwin himself emphasised that he used the expression *struggle for existence* "in a large and metaphorical sense including dependence of one being on another".[552] An evolutionary approach to war emphasises variations and diversity in order to comprehend its rapidly and dynamically changing character. Both biological evolution and war display selection pressures and features that point as much towards co-operation as competition. The resulting synergy employs information and displays innovation. The obvious similarities do not mean that we can equate war and biological evolution in a direct fashion. They do share certain general properties, which allow for a careful application of the same scientific language. Consequently, we applied evolutionary biology to war as a "specific scientific method but without its specific meanings." The metaphor is well suited to approach war both at macro and micro levels, especially in tracing and explaining change. It helps us assume that evolution equals war, mutation stands for achieving an effect, species for armed forces, and genes for soldiers.[553] Thus war is a struggle in which on occasion the correct route is discovered, but often it is not, and more often only partially. Friction of war as outlined by Clausewitz emphasises a constant trial and error process, which plays an important role in the final outcome. There is no straight genetic line in evolution, and also war is full with ramifications and divergences. It requires continuous adaptation, which

---

549 Ovington, C. O.: *War and Evolution*, The Westminster Review, April 1900, p. 414; Vayda, Andrew P.: *Warfare in Ecological Perspective*, Annual Review of Ecology and Systematics, Volume 5, 1974, pp. 183-193.

550 Drapeau, Mark D./Hurley, Peyton C./Armstrong Robert E.: *So Many Zebras, So Little Time: Ecological Models and Counterinsurgency Operations*, Defense Horizons, Number 62, February 2008, pp. 1-8 (quotation. p. 7).

551 Loeb, J.: *Biology and War*, Science, Volume 45, Issue 1152, 1917, pp. 73-76; Mitman, Gregg: *The Biology of Peace*, Biology and Philosophy, Number 12, 1997, p. 260; Vergata, Antonello la: *Evolution and War, 1871-1918*, Nuncius, Volume 9, Number 1, 1994, p. 145.

552 Quoted in Bailey, L. H.: *War and Biology*, The Journal of Heredity, Volume 6, Number 2, 1915, p. 54.

553 Modelski, George/Poznanski, Kazimierz: *Evolutionary Paradigms in the Social Sciences,* International Studies Quarterly, Issue 40, 1996, pp. 315-319 (quotation p. 316).

comes as a result of changing environmental conditions and the unexpected moves of the enemy.[554]

[554] Cole, Leon J.: *Biological Philosophy and the War,* The Scientific Monthly, Volume 8, Issue 3, 1919, pp. 247-253.

14 Strategy Development

"Don't establish the boundaries first the squares, triangles, boxes of preconceived possibility, and then pour life into them, trimming off left-over edges, ending potential: let centers proliferate from self-justifying motions!"

A. R. Ammons

14.1 Evolution and War

The preceding chapters helped us comprehend war as complex optimisation problem in an evolutionary framework. This however, requires a shift from mechanics to biology. An evolutionary framework emphasises dynamics over statics, time-prone over time-free reality, probabilities and chance over determinism, and variation and diversity over uniformity. The effect-genotype is the foundation for this analogy as biological evolution and war share similarities. Although they cannot be equated with each other, in an evolutionary framework, war can be seen as a transforming large-scale system for which biology is uniquely appropriate to trace and explain its bewildering attributes. In other words, "men and animals successful in the struggle succeed because they happen to be best suited to their surrounding conditions, whether those conditions are simple or complex, high or low."[555] In this chapter we explore the consequences of this organic approach in terms of strategy development.

14.1.1 Strategic Mix of Evolution

The effects landscape has far reaching consequences on strategy development. Earlier we demonstrated that in order to improve fitness there are two generic mechanisms such as adaptive walk representing efficiency and random jumps representing effectiveness. Both refer to effects and indicate that effects can basically be achieved through two different, but interrelated ways. Due to dynamically changing circumstances war demands the application of both processes in parallel. Consequently, we have to mix them not only to gain, but also to maintain high fitness. Whereas efficiency means climbing and proceeds through adjacent neighbourhoods, effectiveness stands for exploring neighbourhoods sampled far away. Due to the dynamic surface of the effects landscape the exclusion of one process at the expense of the other can easily result in disadvantages negating the prospect for victory. The mechanism applied must always correlate with the characteristics of the surface. We detailed that early in the process the landscape appears to be uncorrelated and displays a surface that mostly denies the advantages of climbing. In order to escape the correlation structure and avoid being trapped on poor local optima, we must jump until a good peak is found and the process of climbing can

---

[555] Modelski/Poznanski, pp. 315-319; Andreski, *Evolution and War*, Science Journal, January 1971, pp. 89-92; Quotation in Ovington, C. O.: *War and Evolution*, The Westminster Review, April 1900, p. 414; For technology-based approach see Armstrong, Robert E./Warner, Jerry B.: *Biology and the Battlefield,* Defense Horizons, Number 25, March 2005.

start. In other words, we must generate feedback that can be harvested. Thus first we must act or do something then we should identify and select what works, and finally retain only those actions that appear desirable.[556] Only then does an optimisation conducted along some selected dimensions aimed at improving efficiency make sense. However, as we approach the peak further climbing becomes increasingly unattractive since the potential benefit we can gain yields less and less in terms of fitness. Sooner or later we are forced to jump again until another suitable and exploitable peak is discovered.

14.1.2 Efficiency and Effectiveness

We demonstrated earlier that much of war is non-linear and as depicted in Figure 18 achieving effects always comes as a combination of effectiveness and efficiency. In terms of war efficiency means an emphasis on comprehensiveness and not dynamism. Here every move can be planned in advance and in detail.

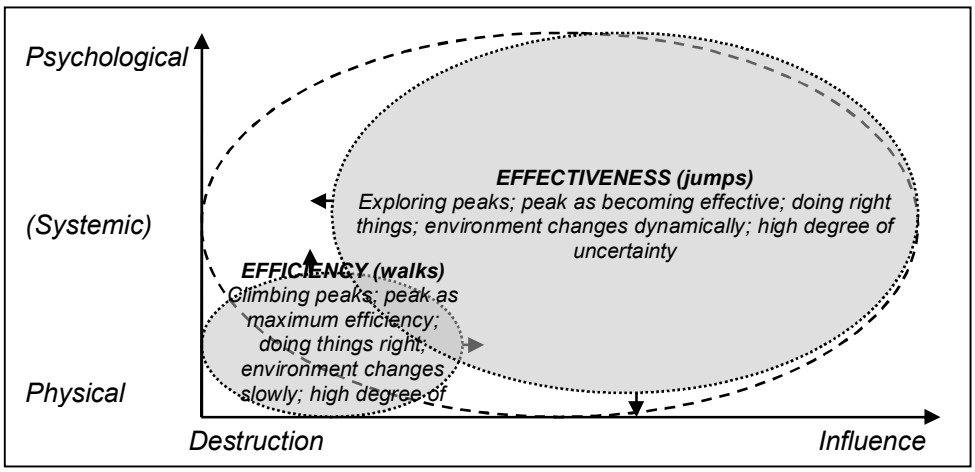

Figure 18: Adaptation in terms of efficiency and effectiveness

Flexibility is sacrificed in order to achieve certain predefined objectives or desired effects that make our actions focused, streamlined and unified. This is the domain that makes an exclusive top-down deductive approach attempting to link the strategic and tactical levels of war by means of direct causality possible. Unfortunately, in a constantly changing environment optimisation focusing on narrowing options often does not make sense. In this case we are better off if we seek exploitable opportunities and are always ready to change and adjust. Instead of relying exclusively on adaptive walks we must also have the courage to jump right across the landscape to find good peaks. This way we do not attempt to impose order, but take disorder as inevitable in war and assume that it also affects the enemy. Consequently, there is a great reliance on bottom-up initiatives based on local information, which is in sharp contrast to the traditional mechanical and deductive approach to strategy development. The two processes can be described by two principles as follows:

---

[556] Mintzberg, H./Ahlstrand, B./Lampel, J.: *Strategy Safari, A Guided Tour Through the Wilds of Strategic Management,* The Free Press, 1998, p. 198.

- *Maximum principle* – is an approach that allows for reductionism and stands for efficiency. It assumes that peaks can be defined and solutions come as a result of *engineering* activities. Optimisation and the drive for perfection make sense since it is possible to focus on single dimensions in order to make things better. Planning and execution are the best means to achieve desired effects.
- *Minimum principle* – is an approach that attempts to exploit the power of metaphors and stands for effectiveness. It indicates that peaks have to be found first in order to achieve useful or *good enough* effects. Solutions mostly come as a result of a messy trial-and-error mechanism. Not control, but coping is possible, which emphasise satisfying and acceptance. Here the focus is on relationships and the way they develop over time and space as a result of adaptation and learning.

14.1.3 Clausewitz and Strategic Thinking

Armed forces put unilateral emphasis on the maximum principle as they mostly employ a one-dimensional strategy. They see strategy in terms of an adaptive walk despite the fact that this process only reveals narrowing options. Armed forces traditionally attempt to realise predefined objectives at every stage and at every level of war. In order to understand this preference we must first look at the meaning of the term *strategy* that is defined in normal English as follows:

- The rather general version describes it as the science and art of employing political, economic, psychological, and military resources in order to achieve maximum support to adopted policies.
- The more particular and military oriented version describes strategy as the science and art of military command in order to meet the enemy in combat under advantageous circumstances.[557]

For Clausewitz strategy meant nothing more than "the use of an engagement for the purpose of the war".[558] He lived in an age in which the aim of war equalled with a clearly expressed political purpose. However, this rational causal construct with a clear and concise subdivision of military means to political ends did not hinder Clausewitz to emphasise that in strategy "everything [had] to be guessed at and presumed".[559] For him, strategy meant a unifying structure to the entire military activity that decided on the time, place and forces of the enemy with which the battle had to be fought. Consequently, its importance came as a result of "numerous possibilities, each of which [would] have a different effect on the outcome of the engagement."[560] The sheer number of possibilities explains why he equated strategy with surprise and argued that "no human characteristic appears so suited to the task of directing and inspiring strategy as the gift of cunning."[561] Although Clausewitz regarded the political aim the ultimate goal of war, he equally argued that the multitude of conditions and considerations prohibits its realisation through a single act. As a result, the political end must be decomposed into military means of different

---

[557] Gove, p. 2256; Brodie, Bernard: *Strategy As Science,* World Politics, Volume 1, Number 4, 1949, pp. 475-478.

[558] Quotation in Clausewitz, p. 207.

[559] Quotation in ibid., p. 211.

[560] Quotation in ibid., p. 228.

[561] Ibid., pp. 238-239 (quotation p. 238).

importance and purpose. This instrumental focus explains his conviction that "only great tactical successes [could] lead to great strategic ones" and his claim that in strategy "there [was] no such thing as victory".[562] Political results on the strategic level could only come from victories fought on the military tactical level. The more the politics on the strategic level is able to exploit military victories gained on the tactical level, the greater the success. This was the very reason for him to claim that in strategy "the significance of an engagement is what really matters".[563]

14.1.4 Modern Attributes, Post-Modern Challenges

Despite all the merits and contribution of Clausewitz to the theory of war, in terms of the effects landscape his efficiency-oriented approach to strategy development appears to be too narrow. Being a theorist of the Second Wave he regarded politics as the supreme reason which tamed and canalised the conduct of war. However, his strong influence on Western military thinking resulted that the common understanding of strategy locked in as a link between military means and political ends, or in a more generalised version between cause and its effect. Thus strategy stands for a scheme for making one to produce the other. Consequently, strategy is understood as a plan that expresses clear cause-and-effect relationships for using available military means in order to achieve certain political ends. It provides a rationale for those actions that help realise political goals. Strategy is seen as a rational or planning activity relating means to ends in a focused and rigid manner despite the fact that in most cases strategy might change in case new means become available or different ends appear to be preferable.[564] We demonstrated that non-linearity stands for the brake-down of ends/means rationality. As an example, in asymmetric warfare and complex contingencies, which are inherently non-linear phenomena, both the formulation of political goals and the application of military means are influenced by the interplay of so many factors that an approach based on rational planning has limited utility. In these cases strategy does not resemble similarity with an elegant forced march, but appears as a messy and painful trial-and-error process in the form of *muddling through*. The effects landscape also indicates a dynamic process in which military means and political ends of the participants become confused. The result is that the means employed and the ends achieved cannot always be delineated sufficiently. The constantly changing surface of the effects landscape best addresses the increasing complexity of the Third Wave and the challenges posed by various irregular forces such as globally networked terrorist organisations not possessing traditional boundaries. In an attempt to address the consequences of the effects landscape in terms of strategy development, the following chapters first detail the current military understanding of strategy and then introduce a more organic approach that takes emergent and self-organising attributes better into account.[565]

---

[562] Ibid., pp. 242, 247, 268-271, 434-462 (quotations pp. 270, 434).

[563] Ibid., pp 617-638 (quotation p. 617).

[564] Betts, Richard K.: *Is Strategy an Illusion?,* International Security, Fall 2000, pp. 5-6; Builder, Carl H.: *The Masks of War, American Military Styles and Strategy and Analysis,* Rand Corporation Research Study, The John Hopkins University Press, 1989, pp. 47-52.

[565] Mintzberg, Henry/McHugh, Alexandra: *Strategy Formation in an Adhocracy,* Administrative Science Quarterly, 30, 1985, pp. 160-162.

14.2 Strategy as Planned Phenomenon

Despite the non-linear character of war the traditional military approach to strategy development can best be described as an *engineering* phenomenon. It is seen as rigid model that rests on ends-means calculation in which we attempt to synchronise between ends sought and means applied. A clear definition of ends is followed by a proper organisation of available means for which objectives are set, options narrowed and choices made. Thus strategy is appraised in terms of ends rather than means and assumes deliberate, rational and goal-attaining entities. Goals are articulated as objectives and come as a result of a general consensus. They are assumed to be ultimate, identified, well-defined and sufficiently few to make them both manageable and measurable. The focus is on how well those specific and established objectives are achieved at every level of military operations.[566] Objectives-based planning emphasises a calculated relationship between ends, ways, and means in which ends represent the objectives sought, means the available resources and ways the concepts that attempt to organise and apply resources in a skilful way. As Clausewitz stated "the subjugation of the enemy is the end, and the destruction of his fighting forces the means."[567]

$$Strategy = Ends + Ways + Means$$

Ends are equivalent to military objectives, ways to military strategic concepts and means to military resources. Strategy focuses on ways in order to employ means to achieve ends. It is a plan of actions in a synchronized and integrated framework that helps achieve various objectives on theatre, national, and/or multinational levels.[568] This framework indicates the military as a self-sufficient system that contains the necessary means both to determine and attain objectives. Planning is seen as a balancing act between the two and supported by the following assumptions:

- The enemy opposition is often regarded as something that falls outside the system. It is seen as an environmental peculiarity that can be overcome. The enemy is simply not allowed to affect clear reasoning, drawing up and pursuit of objectives. War is often subdivided into various headings such as strategy, operations and tactics, and often competence in one area does not mean competence in the other. The military is seen as a rational machine in which decisions are governed by prediction and control.
- High degree of stability and calm is required in order to provide a basis for the rational patterns of orders as the total body of available information is analysed and reduced. War is

---

[566] Feld, M. D.: *Information and Authority: The Structure of Military Organization,* American Sociological Review, Volume XXIV, 1959, p. 15; Beinhocker (1999b), p. 53; Robbins, Stephen P.: *Organisation Theory: Structure, Design, And Application,* Prentice-Hall International Editions, 1987, pp. 31-32; Pirnie, Bruce/Gardiner, Sam B.: *An Objectives-Based Approach to Military Campaign Analysis,* RAND MR656-JS, 1996, p. 3.

[567] Clausewitz, pp. 637, 697 (quotation p. 637).

[568] Dorff, Robert H.: *A Primer in Strategy Development,* p. 11, and Lykke, Arthur F.: *Toward an Understanding of Military Strategy,* pp. 179-180, both in: Cerami, Joseph R./Holcomb, James F. (eds.): *U.S. Army War College Guide to Strategy,* U.S. Army War College, 2001, Internet, accessed 08. 03. 2005, available at http://permanent.access.gpo.gov/lps11754/00354.pdf; Department of Defense: *Joint Publication 1-02, Dictionary of Military and Associated Terms,* 12 April 2001 (as amended through 30 November 2004), p. 509, Internet, accessed 16. 03. 2005, available at www.dtic.mil/doctrine/jel/new_pubs/jp1_02.pdf.

a series of discrete actions in which events come in a visible and serial sequence. Strict military discipline makes it possible that "nothing occurring in the course of its execution should in any way affect the determination to carry it out."[569]

14.2.1 Promoting Inflexibility

The fundamental design of this approach contains neatly delineated steps with objectives placed at the front end and operational plans at the rear. The process of planning starts normally with setting objectives as quantified goals, followed by the audit stage in which a set of predictions about the future is made. Predictions delineate alternative states for upcoming situations, which are also extended by various checklists. In the subsequent evaluation stage the underlying assumption is that similar to firms that make money by managing money, armed forces can make war by managing war. Several possible strategies are outlined and evaluated in order to select one. The following operationalisation stage gives rise to a whole set of different hierarchies, levels and time perspectives. The overall result is a vertical set of plans containing objectives, allocation of resources, diverse sub-strategies and various action programs. The last stage of scheduling is equivalent to the establishment of a programmed timetable in which objectives drive evaluation in a highly formal way as everything is decomposed into distinct and specified elements. The basic assumption is that once the objectives are assembled strategy as an end-product will result. This approach rests on decomposition and formalisation in which strategy development often resembles similarity with mechanical programming.[570] However, due to its linear design this approach can also promote inflexibility through clear directions since it attempts to impose stability. Although everything is built around existing categories emphasising a planned, structured and formalised process, it contains two possible pitfalls:

- *Predictability* – the first is that it presupposes a predictable course of events and an environment that can be stabilised and controlled. Although even in war it becomes possible to predict certain repetitive patterns, forecasting any sort of discontinuity is practically impossible. Thus a quick reaction outside the formalised design is often better than the extrapolation of current trends and hoping for the best.
- *Formalisation* – the second concerns the formalised process that often detaches thinking from action, strategy from tactics, and formulation from implementation. Formalisation requires hard data in the form of quantifiable measures that are often late, thin, and aggregated. Strategy development is seen as a semi-exact science in which courses of actions are put into dry numbers. Although such an approach might once have had an advantage when conducting large-scale military operations, it equally can give room for "strategising and artistic expressions by talented generals."[571]

---

[569] Warden, John A. (Col.): *The Air Campaign, Planning for Combat,* Pergamon-Brassey's International Defense Publishers, 1989, pp. 1-6; Wylie, Joseph C.: *Military Strategy: A General Theory of Power Control,* Naval Institute Press, 1967, pp. 24, 84; Feld, pp. 16-21 (quotation p. 21).

[570] Mintzberg et. al. (1998), pp. 48-63; Mintzberg, Henry: *The Rise and Fall of Strategic Planning,* Prentice Hall, 1994, pp. 49-67; Mintzberg, Henry: *The Design School: Reconsidering the Basic Premises of Strategic Management,* Strategic Management Journal, Volume 11, 1990, pp. 175-180; Cleland, David I.: *Project Management, Strategic Design and Implementation,* TAB Professional and Reference Books, 1990, pp. 21-36.

[571] Mintzberg et. al. (1998), pp. 64-77; Mintzberg, 1994, pp. 257-267; Robbins (1987), pp. 32-33; Beinhocker (1999a), p. 96; Smalter, Donald J./Ruggles, Rudy L.: *Six Business Lessons from The*

In traditional terms strategy is defined by attributes such as "clarity of objective, explicitness of evaluation, a high degree of comprehensiveness of overview, and […] quantification of values for mathematical analysis."[572] These characteristics have been further reinforced by the influx of various scientific tools in the form of operations research techniques that attempt to blend the relative predictability of advanced military technology, modern mathematics and rapid data processing tools. Although such techniques make it possible to estimate the probability of hitting a target with a certain confidence, their power soon erodes when facing problems that cannot be easily translated into quantifiable formulas. Undoubtedly, aggregating military activities into measurable data is technically possible, but the subsequent re-aggregation of analytic results is often unsatisfactory even for the analysts themselves. Consequently, it is at odds with the more complex and constantly changing attributes of the effects landscape.[573]

14.2.2 Objectives-Based Planning

Objectives can best be described as "clearly defined, decisive, and attainable goals towards which every military operation should be directed."[574] The essence of objectives-based planning is that higher-level objectives are decomposed into specific tasks and activities down to the lowest possible level. Thus objectives, tasks and actions are linked hierarchically from top to bottom and across the width and breadth of operations. Clausewitz emphasised that "[n]o one starts a war … without being clear in his mind what he intends to achieve … and how he intends to conduct it. The former is its political purpose; the latter its operational objective."[575] Objectives-based planning relies on the process of identifying objectives, analysing various courses of actions, and ends with a plan. Activities become linked around common elements, and theoretically everybody can see his or her contribution to the overall effort. Obsolete activities can be filtered out and eliminated, activities and resources elaborated based on substitution and scarcity.[576] Forces are tasked to achieve objectives, which constitute the backbone against which campaigns are planned, executed and assessed. It is a Clausewitzian construct in which "series of secondary objectives … serve as means to the attainment of the ultimate goal".[577] Objectives flow from top to down as follows:

- National security objectives form the basis for applying national power in order to secure national goals and interest.
- National military objectives guide the application of military power in various regions of the world.

Pentagon, Harvard Business Review, March-April 1966, pp. 69-74; Mintzberg (1990), pp. 191-193; Quotation in Daven (2004).

[572] Quotation in Lindblom, Charles E.: *The Science of "Muddling Through",* Public Administration Review, Spring 1959, p. 80.

[573] Millett, Allan R./Murray, Williamson: *Lessons of War,* The National Institute, Winter 1988/89, p. 84; Farjoun, pp. 562-563; Mankins, Michael C./Steele, Richard: *Stop Making Plans; Start Making Decisions,* Harvard Business Review, January 2006, pp. 76-80.

[574] Quotation in *Joint Publication 1-02,* p. 308.

[575] Quotation in Clausewitz, p. 700.

[576] Kent, Glenn A.: *Concepts of Operations: A More Coherent Framework for Defense Planning,* RAND N-2026-AF, 1983; Smalter/Ruggles, p. 64; McCrabb (2003), pp. 30-34; McCrabb (2002a), pp. 6-7; Department of Defense (2001), p. 381

[577] Quotation in Clausewitz, p. 228.

- Campaign objectives on a regional operational level guide the successful prosecution of military campaigns.
- Military campaigns are again decomposed into operational objectives in order to position and deploy forces.
- Operational tasks and functions serve to achieve operational objectives.[578]

Strategy has the basic purpose of linking these levels in a coherent and clear framework since achieving a supported objective is partly a statement of supporting objectives. The result is that objectives cascade downwards as strategy at one level becomes objective at a level below. This hierarchy defines the weight of effort among objectives over time at one level needed to attain a higher level objective in any given situation. Strategy links the hierarchy of objectives and provides the framework for achieving them. At each level objectives and strategies are accompanied by a set of processes and actions defined by various criteria and constraints. This sort of strategy development places a premium on mass information since the execution requires that those involved have access to all relevant aspects. Unfortunately, we demonstrated earlier that due to the frictional, chaotic and complex reality of war information is mostly inaccurate, untimely and incomplete with key pieces missing or hard facts lacking.[579] Objectives were well suited to the traditional levels of modern wars fought during the Second Wave. National security objectives and national military objectives are on the strategic level, expressed in political-military terms and serve as a framework for the conduct of campaigns and major operations on the operational level. Tactical level battles and engagements are fought in order to achieve higher level objectives. Thus objectives at each level are linked to a source or actor within the hierarchy. They proceed from the general towards the particular in a deductive fashion until those actions that help attain higher level objectives are identified. This hierarchical design puts emphasis on vertical relationships despite the fact that some aspects may be well understood and quantifiable, but some more remain uncertain. The broad assumption is that lower-level objectives help attain objectives on a higher level as the output from one objective serves as input for others.[580]

14.2.3 Objectives-Based Confusion

Although objectives-based planning presupposes that objectives are defined in a clean and coherent way, there is always a risk that the hierarchical order breaks down. The complexity of the challenges in the Third Wave can also result that we might increasingly witness situations in which national military objectives are not articulated in a sufficiently clear and concise way. This hinders the proper articulation of campaign objectives, which again cannot contribute to coherent operational objectives. The result is that the entire process shifts towards hedging against the worst case, and ends up with completely inappropriate options. A good example for confusion of this kind was the bombing campaign during Operation Allied Force in which the final campaign plan, with its phased and incremental nature, left the planners mostly confused regarding the

---

[578] Thaler, David E./Shlapak, David A.: *Perspectives on Theater Air Campaign Planning,* RAND MR-515-AF, 1995, pp. 5-7; Kent, Glenn A./Simons, William E.: *A Framework for Enhancing Operational Capabilities,* RAND R-4043-AF, 1991, pp. 10-15.

[579] Thaler/Shlapak, pp. 8-12.

[580] Pirnie/Gardiner, pp. 3-20.

effect their actions should have on the enemy. Joint Publications 1-02 defines strategy as the "art and science of developing and employing instruments of national power in a synchronized and integrated fashion to achieve theater, national, and/or multinational objectives".[581] Unfortunately, fighting irregular forces such as terrorist organisations means the involvement into asymmetric conflicts. It will be increasingly difficult to identify useful and coherent objectives that can guide military actions as often what appears to be desired might change under reconsideration. Although an adequate intelligence support infrastructure is a prerequisite for selecting an appropriate strategy, the feedback loop required for planning, execution and assessment can easily break down. The result is that accurate information does not flow rapidly with consequences ranging from superfluous repetition of actions to dangerous negligence.[582] Despite the supposed neat and streamlined design of objectives it is most likely that in the Third Wave the absence of clear guidance from higher echelons in the form of objectives will increasingly become the rule not the exception. More often, those who should define objectives will be in great need and may demand to get objectives suggested from below. This may pose a crucial challenge in cases in which national- and theatre-level objectives are not well defined or there is no clear causal relationship between military options and desired political results. Due to the complexity involved, the relationship between military means and political ends can either be subject to uncertainties or poorly understood.[583] The situation decision-makers might face can become so highly variable and change so rapidly that the entire hierarchical design gets out of balance, and we should never expect definite and well-understood inputs to objectives. The assumed clear policy guidance in the form of objectives can often be ambiguous as various fields may overlap or become contradictory. Furthermore, policy makers often will have to juggle numerous values simultaneously without always making their rank order clear. Consequently, even with this well structured, engineering-oriented, semi-scientific approach, it becomes impossible to express and describe objectives with the required detail. Another problem is that objectives expressed on the highest level tend to be increasingly abstract. Although they often rely on direct and clear causality, their relevance soon erodes as we move down the hierarchy.[584] As a precaution often menus of objectives are suggested to provide a certain baseline for times when the expected guidance from above is either insufficient or unclear. Instead of thinking in a single and rigid plan it is believed that a spectrum of plans forming a pool of various strategic concepts can provide for useful strategies in the case the situation changes, or fails to proceed as assumed originally. However, in terms of the effects landscape that displays war as a complex optimisation problem it is very questionable whether it becomes ever possible to establish a sufficient pool of flexible and non-committal objectives that can cover the vast array of emerging possibilities.[585]

---

[581] Polumbo, Harry D. (Col.): *Effects-based Air Campaign Planning: The Diplomatic Way to solve Air Power's Role in the 21st Century,* Air War College, Air University, Air Force Academy, April 2000, pp. 6-24; Quotation in *Joint Publication 1-02*, p. 383.

[582] Thaler/Shaplak, pp. 15-22; Lindblom, p. 86.

[583] Pascale, p. 88; Lindblom, pp. 82-83.

[584] Thaler/Shaplak, pp. 37-41; Pirnie/Gardiner, pp. 21, 79-83; Pascale (1999), p. 91, Betts, p. 13; Richards, Diana: *Is Strategic Decision Making Chaotic?,* Behavioral Science, Volume 35, 1990, pp. 222-224, 232.

[585] Wylie, p. 84-85.

14.2.4 Empirical Testing – Objectives and Kosovo

A good example for practical problems coming from unforeseeable events and confusion can be found in the way NATO's Kosovo Force was deployed in 1999. Despite heavy bombings and the assumption that advancing troops would find demoralised Yugoslav troops, the reality turned out to be different. Yugoslav troops withdrew from the province in a disciplined manner verifying the fact that even if *n* possible scenarios can be identified, the actual would always be an *n+1* that could not be forseen. Although the original mission was to enforce peace and deter the renewal of hostilities, as time passed the mandate emerged more into the civilian sphere and became essentially vague. Despite all efforts prior to the deployment intelligence gathering was poor and soldiers entering Kosovo faced a largely unknown situation. As General Sir Mike Jackson, then commander of Allied Rapid Reaction Corps concluded, in the end the campaign in Kosovo was lucky to be a success as potential enemies largely complied and took no particular actions to upset the plans. Thus he did not feel the need to refer to any sort of excellence in terms of planning and execution. Clear and concise instructions regarding the UÇK were mostly lacking, oral instructions were unclear and not confirmed in writing. Especially in the beginning, local commanders were forced to defuse the situation on a learning-by-doing basis in ad hoc arrangements in the field. Regarding other aspects of the mission KFOR soldiers were also left mostly in the dark as to how law enforcement had to be addressed. Thus they had to fill a vacuum and often had no idea of how to do it. Only five weeks after the first troops entered Kosovo, was General Jackson able to formulate at least his intent in broad terms to guide commanders down to company level and to achieve some sort of unity in KFOR's effort. Unlike the certainties of the Second Wave in general, and the Cold War in particular, it appears that in the Third Wave we will have to learn to embrace rather than eliminate uncertainty.[586] In other words, first we have to jump quite a few times until a suitable peak can be identified. This however, means also that assumptions regarding Boyd's famous observe-orient-decide-act loop are at least partly flawed. An *act-observe-orient-decide* loop, which first generates options in the form of feedback, might be much closer to reality.

14.2.5 Objectives and the Effects Landscape

As detailed earlier, strategy development based on objectives can best be described as a maximising approach since it attempts to control everything that may happen on the effects landscape. Despite the discrepancy between the relative rigidity and linear character, and the increasing complexity of situations found in operations world-wide, the temptation to stick to this approach is as strong as ever. This fact also explains why the concept of effects-based operations is often understood as a planning methodology that emphasises the explicit linking of strategic-level objectives with strategic-level effects in order to achieve objectives in a more coherent and streamlined fashion. Thus effects-based operations are understood more as an aid that adds to the power of the objectives-based approach instead of seeing the concept as an opportunity to find new approaches to strategy development.[587] The biggest shortcoming of the

---

[586] Brocades Zaalberg, Thijs W.: *Soldiers and Civil Power, Supporting or Substituting Civil Authorities in Modern Peace Operations*, Amsterdam University Press, 2006, pp. 289-340.

[587] Ho How Hoang, Joshua (Lt. Col.): *Effects-Based Operations Equals to "Shock And Awe"?,* Journal of the Singapore Armed Forces, Volume 30, Number 2, 2004, Internet, accessed 30. 08. 2004, available at http://www.mindef.gov.sg/safti/pointer/back/journals/2004/Vol30_2/7.htm; McCrabb (2001), p. 35; NATO Strategic Commanders: *Strategic Vision: The Military Challenge,* MC 324/1, as of 12. 01. 2003, p. 15,

objectives-based approach is its limited ability to adapt, which is discouraged as much by the articulation of objectives as by the separation between formulation and implementation. Despite the claim of being flexible, its very essence is to realise specific objectives as the focus is on realizing rather than adapting them. Focusing on objectives is quantitative since it mostly deals with static states and not the transitions between possible states. It is a step-wise and incremental approach that proceeds hierarchically through the various levels of war, despite the fact that such links can become weak or even disappear as events unfold. The effects landscape indicates a dynamic and constantly changing co-evolutionary process, in which events are also influenced by what common wisdom would term external circumstances or luck. It is often mentioned that a comprehensive understanding of objectives is needed, which requires that commanders must look at both above and below their respective levels.[588] However, such demand can easily put commanders under increased pressure and lower overall performance. Objectives-based planning attempts to see the end from the beginning and by going into ever finer detail it reflects linear causality. Unfortunately, war seen as a complex adaptive system indicates that much of the continuum is non-linear and messy. Thus the effects landscape has serious consequences for such an approach:

- Objectives-based planning claims to identify single peaks and the path leading to those peaks despite the fact that the surface changes dynamically and in an unpredictable way.
- By going step-wise through the tactical, operational and strategic levels, objectives-based planning suggests that objectives simply add together and war can be seen as a sum, and not the product of many factors.
- Instead of creating options and opening up new possibilities by discovering niches, objectives-based planning shuts down or at least limits the chance of exploiting emergent opportunities.
- In sum, objectives-based planning means that we "pursue relatively singular strategies and thus occupy only one spot on the landscape", but do not employ any mechanism that provides for protection "when the landscape unexpectedly changes".[589]

14.2.6 Further Considerations

Clausewitz's contribution to strategic thinking is unquestionable. However, his goal-seeking approach excludes a whole range of other aspects such as logistic, social and technological issues, which must be considered as equally important in military operations. This focus should not come as a surprise since he believed that every human activity is a rational undertaking and governed by reason. This also explains why he understood strategy as an objective-oriented, goal-seeking phenomenon.[590] This sort of strategy dominated most of the 20th century and is still

---

Internet, accessed 17. 01. 2005, available at http://www.dmkn.de/1779/ruestung.nsf/cc/WORR-66SFNQ.

[588] Mintzberg/Waters J. A.: *Of Strategies, Deliberate and Emergent,* Strategic Management Journal, Volume 6, 1985, pp. 261, 270; Pirnie/Gardiner, pp. 79-83; Senglaub, Michael: *Course of Action Analysis within an Effects-Based Operational Context,* Sandia Report, Sand2001-3497, November 2001, pp. 7-8, Internet, accessed 23. 09. 2004, available at www.infoserve.sandia.gov/cgi-bin/techlib/access.control.pl/2001/013497.pdf; Chakravarthy, Bala: *A New Strategy Framework for Coping with Turbulence,* MIT Sloan Management Review, Winter 1997, p. 77; Lykke (2001), p. 184.

[589] Quotations in Beinhocker (1999a), pp. 100, 102.

[590] Howard, Michael: *The Forgotten Dimensions of Strategy,* Foreign Affairs, Summer 1979, p. 975; Millett/Murray, p. 84; Ehrenreich, p. 7.

dominant today. However, the unpredictability of war indicates clear problems with this sort of strategy image as follows:

- *Gambling* – despite the neat and clean logic behind, planned strategies often resemble gambling. Although they rely on planning and careful evaluation of numerous factors, it is impossible to predict in advance which risk is more reasonable in selecting a particular course of action. Thus there will always be a certain error in the estimation regarding what we know and what we expect.
- *Contingency* – the inherent contingency of war limits the ability to control causes sufficiently well in order to produce desired effects. Friction, chaos and complexity always include the probability of failure since they provide only for an insufficient basis for any estimates regarding odds. Strategic calculation is by definition vague, which also limits the possibility of causing intended effects.
- *Personality* – the personal character of decision-makers often distorts strategy. Thus power is as much applied for manifest political purposes as for subliminal personal ones, which can heavily influence the link between military means and political ends.
- *Cognition* – strategic decisions always go through non-logical filters such as bias and prejudice. Thought processes are influenced by cognitive constraints, which limit the decision-maker's ability to see or calculate linkages between causes and effects in a comprehensive way. Conscious calculations can often be non-rational as we tend to see what we expect to see.
- *Communication* – strategies, especially coercive ones aimed at influencing will depend mainly on communication. However, due to cultural blinders the receiver often cannot hear the message sent by the signaller. Logical strategic calculations only have reference within their own cultural context.
- *Friction* – as detailed earlier normal operational friction can significantly influence the way plans are executed and decouple assumed causes from expected effects as coercive signals that depend on coupling often collapse.
- *Deflection* – through deflection the process of implementing stated political goals can often be influenced, even resisted, by established organisational routines. Habits and interests can distort the way means are applied with the result that stated goals and objectives become closer to parochial priorities that reflect organisational stability rather than larger political aims.
- *Sequence* – strategy has the purpose of shaping the courses of action that suit policy. Unfortunately, the enemy does not co-operate, but opposes any neat and clean execution of plans. Thus the proper sequence of causes and effects is usually disturbed or reversed and does not unfold according to expectations.
- *Constraints* – opposing preferences also constrain options since they require compromise, which is useful politically, but can be harmful militarily. Political compromises can result in military half-measures that serve no strategic objectives. Such options can be acceptable to all, but ideal for none since not doing or over-doing is often better than doing something in-between.[591]

[591] Betts, pp. 8-40, 43-44.

14.2.7 Continuum of War Revisited

It became clear above that in most cases attempts to realise objectives can become an illusion, although sometimes they might work and under fortuitous circumstances they might even work quite well. As depicted in Figure 19, despite all efforts to plan and conduct carefully designed operations focusing on influence and control, the continuum of war does not exclude blunt one-sided conventional attrition campaigns. In other words, brute-force campaigns involving impunity of the stronger can often be equally effective.

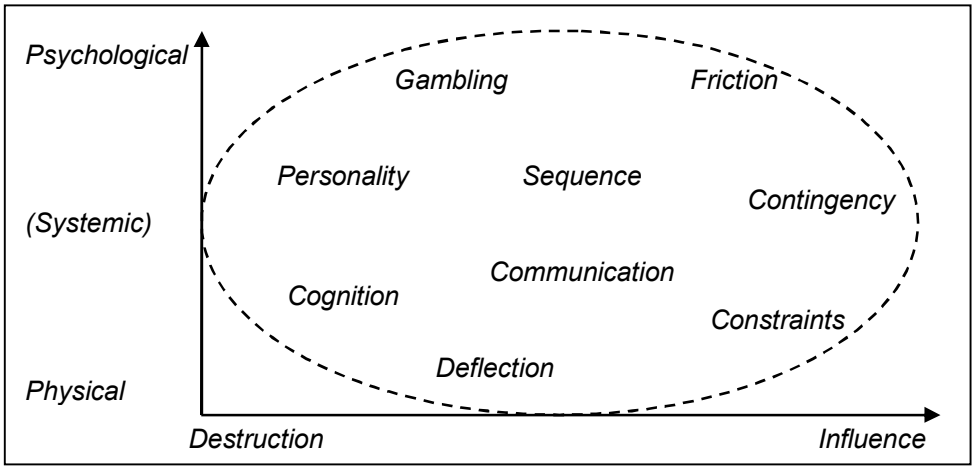

Figure 19: Elements of unpredictability in war

Asymmetric warfare, complex contingencies, irregular combat fought in urban areas or on difficult terrain always constrain the ability to find and target the enemy and can turn war into a very hard and frustrating process. In such warfare the enemy raids, evades, subverts, submerges and withdraws which both confuses carefully selected objectives and desired effects thus negating planned strategies. In a complex environment involving a multitude of players and motives *strategic wisdom* can be more important than any formalisation, which makes strategic success very costly and in some cases impossible. The most difficult and painful aspect of confronting an enemy has traditionally been learning, adapting and embedding the lessons learned into the collective memory of the armed forces. Learning on the battlefield is a nasty business that does not provide for a clear and distinct picture. In the case we stick to the fact that a complex adaptive system stands for polarities to manage rather than problems to solve we must revise the meaning of strategy. Thus strategy development must rest not only on traditional constructs such as plan, implement, and pursue, but also on constructs that emphasise the impact of changing battlefield conditions. Unpredictability of war indicates that the character of the enemy, the threat and the environment constantly change in a difficult-to-comprehend and complex way as the continuum of war displays both linear and non-linear attributes.[592] Consequently, we do not claim that there is no need for deliberate planning in strategy anymore, but emphasise that it is equally important to take emergence and self-organisation much more into account as even the most sophisticated models cannot predict the reality with all its

[592] Millett/Murray, pp. 85-93; Grant, Robert M.: *Strategic Planning in a Turbulent Environment: Evidence from the Oil Majors,* Strategic Management Journal, Volume 24, 2003, p. 506.

variables. In other words, an approach that emphasises exclusively the realisation of clear goals stated in the form of desired effects and demands to "assess … strengths and weaknesses, plan systematically on schedule, and make the resulting strategies explicit are at best overly general guide-lines, at worst demonstrably misleading precepts to organizations that face a confusing reality."[593]

14.3 Strategy as Emergent Phenomenon

In planned top-down strategies objectives have the function to avoid confusion by reducing possible internal tensions as they make things focused, streamlined and quantifiable. However, one important consequence of the effects landscape is that due to the constantly changing surface it is difficulty to see the end from the beginning. The result is the "unpalatable fact that no one can predict the long-term … environment with any accuracy."[594] The effects landscape indicates that it is impossible to see the shape the future will take as there is not one predetermined future, but many possible. Although in traditional terms strategy relies mostly on linear cause-and-effect relationships, if the dynamics of the effects landscape blur temporal and spatial dimensions, such an approach is simply inappropriate. An evolutionary approach to strategy development stands for creativity, constant change, evolving situations and limitations regarding comprehension, prediction and control. Conditions found in the effects landscape do not provide for *safe havens* or *free lunch* and any strategy that rests on prediction and planning is marginally helpful at best and downright dangerous at worst. Dynamic interactions cannot be engineered and controlled in a mechanistic way. Much depends on chance as possibilities always emerge and form a broad spectrum, with the result that narrow predictions indicate an entirely wrong mind-set for a phenomenon that is inherently unpredictable.[595] The effects landscape does not stand for certainties, but reminds us that there are only possibilities in the form of options. Consequently, any strategy aimed at harnessing emergence and self-organisation must refocus from prediction and rationality. The various events and activities that influence and determine the course of actions require a different approach.[596] We are forced to create or track emerging opportunities that can be exploited rather than attempting to realise objectives of a predefined and analytically elaborated plan. An evolutionary approach to strategy development demands qualities such as flexibility, robustness, learning, and adaptation. Although they do not help reducing uncertainty, but help exploit the constantly shifting opportunities it contains.

---

[593] Quotation in Mintzberg, Henry*: Patterns in Strategy Formation*, Management Science, Volume 24, Number 9, May 1978, p. 948.

[594] Quotation in Williamson, Peter J.: *Strategy as Options on the Future,* MIT Sloan Management Review, Spring 1999, p. 118.

[595] Pascale, pp. 84-90; Courtney, Hugh/Kirkland Jane/Vigueri, Patrick: *Strategy Under Uncertainty,* Harvard Business Review, November-December 1997, pp. 66-69; Beinhocker (1999a), p. 96.

[596] Macintosh, Robert/Maclean Donald: *Conditioned Emergence: A Dissipative Structures Approach to Transformation,* Strategic Management Journal, pp. 298-290; Moncrieff, J.: *Is Strategy Making a Difference?,* Long Range Planning, Volume 32, Number 2, 1999, pp. 273-276.

14.3.1 Flexibility and Robustness in Evolution

With the effects landscape we can also address the various revolutions that have taken place in the field of military affairs, technological developments and information processing capabilities all blurring traditional strategic boundaries.[597] In the case of asymmetric and complex challenges the three traditional levels of war can often merge into a single integrated universe in which actions at the lowest level cause dramatic changes that ripple upward simultaneously. Although the effects landscape denies prediction, it appreciates the power of evolution that calls for strategies, which are more robust and adaptive than a traditional strategy with a narrow focus. From a traditional point of view these strategies may not be optimal in every scenario, but they can survive under a wide array of changing circumstances and always keep options open over time. In order to minimise irreversible commitments they refocus from certainty, efficiency and co-ordination, but offer flexibility and a higher probability of overall success. Bottom-up emergent strategies are powerful enough to account for the uncertainty of the effects landscape and the probability of different potential outcomes. Emergent strategies indicate that selection pressures internally can better address external selection pressures that come from an ever-changing environment. Robust emergent strategies acknowledge that nothing is just *out there* as a separate entity, but is created through a constant co-evolution. Emergence indicates open strategic options and the possibility of various paths that can better contribute to a rapid change of directions as events unfold.[598] We detailed earlier that in a complex adaptive system causes and effects are separated in time and space. Focusing on objectives and desired effects means putting on blinders as we normally look either for the most immediate or the most obvious cause. We have to expect many hidden trigger points that are responsible for the extremely fluid and haphazard conditions, which so often turn confusion into the very essence of war.[599] Robust and emergent strategies can better address problems in which threats are diffuse, uncertain and unpredictable, and make it increasingly impossible to "skilfully formulate, coordinate, and apply ends, ways, and means".[600] The effects landscape indicates a profound difficulty in foreseeing the course of events since in dynamic and non-linear settings effects do not always directly follow causes. A creative and evolving enemy capable of initiating conditions that are far from equilibrium also defies assumptions regarding clear causality. Dealing with emergent strategies can cause internal tensions that seem to be inefficient as the simultaneous pursuit of contradictory paths runs counter to a traditional understanding. However, they can leverage core skills and assets by creating various options, possibilities and choices. The effects landscape reminds us that it is better to accept conditions of unpredictability and constant change in which strategy is not an exclusive mechanical downstream business, but something that can also emerge. Emergent strategies never assume that a particular input produces a particular output, but indicate probabilistic occurrences within the domain of focus.[601] Strategy in traditional terms

---

[597] Chakravarthy, p. 69; Quinn, James Brian: *Strategy, Science and Management,* MIT Sloan Management Review, Summer 2002, p. 96.

[598] Quinn, pp. 96-105; Dent, p. 13; Williamson, p. 118; Luehrman, Timothy A.: *Strategy as Portfolio of Real Options,* Harvard Business Review, September-October 1998, pp. 90-91, 95-96.

[599] Geus, Arie P. de: *Planning and Learning, At Shell planning means changing minds, not making plans,* Harvard Business Review, March-April 1988, p. 74; Warden (1989), pp. 1-6; Feld, pp. 16-18.

[600] Beinhocker (1999b), pp. 49-55; Chilcoat, Richard A.: *Strategic Art: The New Discipline for 21st Century Leader,* in Cerami/Holcomb (2001), p. 203-208 (quotation p. 207).

[601] Pascale (1999), pp. 84-88, 90, 94.

relies on the assumption that the enemy is known and rational. However, the continuum of war is full of corrections where the pursuit of objectives on a once-and-for-all basis is mostly impossible and success often comes as a result of actions that respond to changing circumstances. Emergence requires constant adjustments especially in the case of incomplete and changing information. It also indicates that in a dynamic and ever-changing environment such as war a bottom-up inductive approach can often be more helpful than the pursuit of a top-down master plan.[602] The structural analysis earlier demonstrated that effects always interact in a dynamic web of relationships and show all sorts of different and intricate behaviour. Their interactions and couplings often result in conflicting constraints that defy the logical rigor behind assumed cause-and-effect relationships. Although emergent strategies are of little help in predicting the future, they can be a valuable aid in promoting insights into how to become a good evolver. Traditional strategies require clear statements in the form of objectives. The frictional, chaotic and complex reality of war stands for a variety of possible futures in which objectives and desired effects, however clearly and concisely stated, can perform badly. Emergent strategies often conflict and are intrinsically difficult to manage, but the greater the uncertainty, the greater their potential and real value. They do not presuppose the identification of the most or least likely outcome, but cover a broad array of possibilities as they evolve over time with some succeeding and some failing. Thinking about war in terms of a complex adaptive system indicates that victory is less the result of a sustained competitive advantage, but more of a continuous development of learning and adaptation aimed at exploiting temporary advantages. The emphasis is on keeping things that work in order to maintain sufficient variation based on innovation and novelty.[603]

14.3.2 Evolution as Learning and Adaptation

Evolution is full of adjustments that come as a result of learning and adaptation. Both the interactions with the enemy and environmental changes influence strategic options by forcing a certain pattern onto the stream of actions. In other words, the frictional, complex and chaotic nature of war brings any strategy closer to a compromise position. Environmental factors neither pre-empt all choice nor offer unlimited choice. They just limit what the belligerents can do, and with learning and adaptation we acknowledge that messages from the environment cannot be blocked out. Evolution means searching for viable patterns or consistency in order to increase flexibility and responsiveness. Learning and adaptation are especially important if the environment is either too unstable or complex to fully comprehend, or too imposing to buck against. They enable us to respond to an evolving reality properly without focusing on a stable and planned fiction. The various combinations of couplings and interactions demonstrated that effects cannot always be assessed a priori. Consequently, they must be discovered empirically through actions that test where the enemy's strengths and weaknesses are. Emergence and self-organisation surrender control to those who have actual and detailed information to shape realistic strategies. As learning and adaptation indicate, it is often more important to respond to an unfolding and ever-changing environment than realise detailed, but inappropriate plans.[604] In

---

[602] Wildavsky, Aaron: *If Planning is Everything, Maybe it's Nothing,* Policy Science, Volume 4, 1973, p. 134; Wall, Stephen J./Wall, Shannon R.: *The New Strategists, Creating Leaders at All Levels,* The Free Press, 1995, pp. 4-19.

[603] Beinhocker (1997), pp. 27-36.

[604] Mintzberg/Waters (1985), pp. 268-272; Luehrman, p. 89.

a complex adaptive system such as war, significant strategic redirections can often originate in little actions and decisions often initiated by "the foot soldier on the firing line, closest to the action."[605] Learning and adaptation mean that various levels interact and mutually adjust in order to reach consensus. Emergent strategies can arise everywhere. As time passes and interactions with the enemy evolve, some strategies may proliferate often without being recognized or consciously managed as such. Learning and adaptation indicate that strategy development is driven more by external forces and internal needs, than the conscious thoughts of the actors. Emergent strategies break with the traditional understanding of strategy that often relies on the separation of planners and executants.[606] Learning and adaptation stand for the fact that it is sometimes better to let patterns emerge than impose an artificial consistency prematurely by stating highest level objectives and desired effects, and decomposing them into lower level actions and tasks. Those who are in constant touch with the enemy develop their own patterns that can lead to strategy either spontaneously or gradually over time. In a dynamic and changing environment it is not always possible to predict where strategies emerge or plan for them. They often just pop out as the various patterns proliferate and influence the behaviour at large. Thus strategy is often less the result of a conscious and formal process, but more of collective actions that simply spread through. As they evolve through experiments new directions can be established and exploited, which indicate that it is important to have a climate within which a wide variety of strategies can grow and contribute to a good balance between internal variation and external demand.[607]

14.3.3 Learning from Passchendaele

The effects landscape requires responsibility for engendering change and opening up new possibilities. Rapid and continuous responsiveness coupled to a minimum of organizational momentum emphasises a myopic and disorderly process. Similar to the frictional, chaotic and complex reality of war, learning and adaptation indicate that brilliance often does not come from foresight expressed in a carefully designed plan. War as a complex adaptive system requires the capacity and willingness to learn and adapt, which mostly come from qualities such as tolerance and commitment.[608] Learning and adaptation stand for trial-and-error and indicate that it is often more important to learn from failures than from success. Although failures are often costly and the temptation to bury and forget is traditionally large, some of the costs can be recouped and a thorough reflection can help hidden shortcomings to surface. Thus it is often better to make a sufficiently good decision in time than to make an excellent decision later, as it is often better to fire more shots than to start improving one's aim.[609] Murky battlefield lessons must be put into accurate and perceptive after-action reports in which reporting is consistently honest and the bearer of bad news is not punished. Individuals should be afforded the freedom to fail as only

---

[605] Quotation in Mintzberg, Henry: *Crafting Strategy,* Harvard Business Review, July-August 1987, pp. 70-71.

[606] Mintzberg et al. (1998), pp. 177-198; Feld, p. 20.

[607] Mintzberg, H.: *Mintzberg on Management: Inside Our Strange World of Organisations,* The Free Press, 1989, pp. 213-216; Mintzberg et al. (1998), pp. 196-197.

[608] Mintzberg/McHugh, pp. 191-196.

[609] McGill, Michael E./Slocum, John W.: *The Smarter Organisation, How to Build a Business that Learns and Adapts to Marketplace Needs,* John Wiley & Sons, 1994, pp. 74, 79-81; Kanter, p. 81.

through failure is it possible to experience success. We have to strive for a constant improvement even if everything appears to be well at first sight. As an example Passchendaele was a disaster in World War I because of the "combined effect of the [commander's] tendency to deceive himself; his tendency, therefore, to encourage his subordinates to deceive him; and their loyal' tendency to tell a superior what was likely to coincide with his desires."[610] Structural inertia often prohibits detecting novel ways that might have the power to replace existing routines, systems and procedures. Emergent strategies assume that those closest to the frontlines know more than the remotely located headquarters, since traditionally "staff information eludes comprehension because it is esoteric; line information because it is trivial."[611] Learning and adaptation mean looking outside our own boundaries of knowledge. Mobilising this knowledge through various forms of interaction is important since it must be ensured that relevant knowledge finds its way to the unit that needs it most.[612] Emergent strategy development might on occasion equal with the conduct of random experiments. However, it always requires the readiness to be exposed to the evolving interactions with the enemy and the willingness to learn from him. An evolutionary approach to strategy development emphasises less rationality and more common sense. It indicates strategic wisdom, which comes less as a result of a formalised intellectual knowledge backed by analytically written reports full with abstracted facts and figures, but stands for personal knowledge that comes from an intimate *sensing* of the situation. Emergent strategies reflect that the frictional, chaotic and complex reality of war forces us to accept surprise and situations of no choice. Thus learning and adaptation mean linking the present with the future through experience, rather than linking the past with the future through analysis.[613]

14.4 War as Organic Strategic Ecosystem

According to traditional understanding strategy is regarded as cerebral and formal: therefore decomposable into distinct steps and checklists. Objectives emphasise a focused vision, which is mostly elitist and harnesses only a small proportion of the organization's creative potential. Evolutionary strategies emphasise emergence in the form of learning and adaptation, which require peripheral vision in order to detect and take advantage of unfolding opportunities. They indicate that it is insufficient to "preconceive specific strategies, but also to recognize their emergence elsewhere … and intervene when appropriate."[614] Conceptualising war in the framework of the proposed Organic Strategic Ecosystem requires that we take both options equally into account. By applying the two sorts of strategy development in parallel, we can best exploit war's unpredictable mechanism. Harmonising internal diversity and external demand

---

[610] Quotation in Liddel Hart, Basil H.: *Through the Fog of War,* Faber and Faber Ltd., 1938, p. 346; Mankins/Steele call this the *business-unit effect*, see p. 78.

[611] Quotation in Feld, p. 18.

[612] Hamel, Gary: *Strategy as Revolution,* Harvard Business Review, July-August 1996, p. 75; Lampel, Joseph: *Towards the Learning Organization,* in: Mintzberg et al. (1998), pp. 214-215; Millett/Murray p. 89.

[613] Mintzberg, H.: *Reply to Michael Goold,* California Management Review, Volume 38, Number 4, Summer 1996, pp. 96-97; Mintzberg (1987), p. 74.

[614] Mintzberg, Henry/Lampel, Joseph: *Reflecting on the Strategy Process,* MIT Sloan Management Review, Spring 1999, p. 22; Mintzberg (1987), pp. 74-75 (quotation p. 75); Hamel, p. 70.

means that we can both strive towards perfection as indicated by efficiency, and find attractive opportunities for which effectiveness stands for. Whereas the former presupposes unity of perspective and diversity of purpose, as the planners are assumed to be at the top of the organisation and the executants down below, the latter emphasises diversity of perspective and unity of purpose by acknowledging that strategists can also be found deep in the organisation. Organic Strategic Ecosystem indicates that influential and important ideas useful for strategy development are distributed widely, reaching even to the peripheries where soldiers are forced to tackle with fewer resources and information, and exposed to factors that often defy ideas coming from the top. In a dynamic and constantly changing environment it is impossible to predict the very places in which useful ideas form; therefore the net must be cast as wide as possible. From a bottom-up perspective the organisation also tends to appear in the form of core competencies rather than a collection of various units and other elements. Integrating both top-down and bottom-up characteristics into strategy development means establishing something like *planned emergence* or *emergent planning*. These contradictory terms emphasise strategy development both as a bottom-up and as a top-down process. Whereas the former enables subordinates to exhibit autonomy and flexibility, the latter secures a certain degree of compliance throughout the organisation in order to avoid fragmentation of resources. In contrast to the traditional exclusive focus, this way it becomes possible that voices are heard and options explored since lack of diversity can lead to dogmas requiring little more than compliance.[615] This synthesis broadens both our understanding and provides information regarding constraints in terms of causality. Seeing strategy development as a simultaneous top-down and bottom-up process can help rule out unnecessary factors and define how they complement or constrain one another in space and time. It does not mean that we exclude the possibility to achieve psychological effects. It rather indicates that waging war always requires that based on the context, we focus as much on destroying the enemy as influencing him. Although this conceptualisation of effects-based operations is less ambitious, it better takes the frictional, chaotic, and complex reality of war into account.[616] In order to detail the consequences of the Organic Strategic Ecosystem in terms of strategy development and to be in accordance with the structural analysis detailed earlier, we introduce three new approaches such as *strategy as mission*, *strategy as rules* and *strategy as patches.* They move away from focusing on predefined and static end-states aimed at synchronizing all activities of military forces towards ideas in which diverse elements of an endeavour collaborate simultaneously. The three approaches help us cope with dynamic, uncertain, and high-risk environments in which neither prediction nor planning is fully possible. Thus they are best suited to situations in which traditional approaches cannot cover all cases as we face situations that are complex and not controllable. As depicted in Figure 20, the more we venture into non-linearity the more we have to expect emergence and self-organisation. Consequently, the more flexibility is required. Whereas the first of the three approaches can be seen as the most known and is familiar for

---

[615] Hamel, pp. 76-80; Goold, Michael: *Research Notes and Communications Design, Learning and Planning: A Further Observation on the Design School Debate,* Strategic Management Journal, p. 170; Chakravarthy, p. 80; Grant (2003), pp. 512-515; Wildavsky, pp. 143-144; Wall/Wall, pp. 63-80; Kanter, Rosabeth Moss: *Strategy as Improvisional Theater,* MIT Sloan Management Review, Winter 2002, pp. 76-81.

[616] Plutynski, Anya: *Explanatory Unification and the Early Synthesis,* British Journal for the Philosophy of Science, Volume 56, 2005, pp. 605-607.

many, the two others can be described as rather novel and thought-provoking. In fashionable terms the first stands for an attempt to *self-synchronise*, the second for an attempt to *de-synchronise*, and the last for an attempt to *a-synchronise*. All three approaches suggest that in case we face uncertainty we should not pull the reins to take more control.

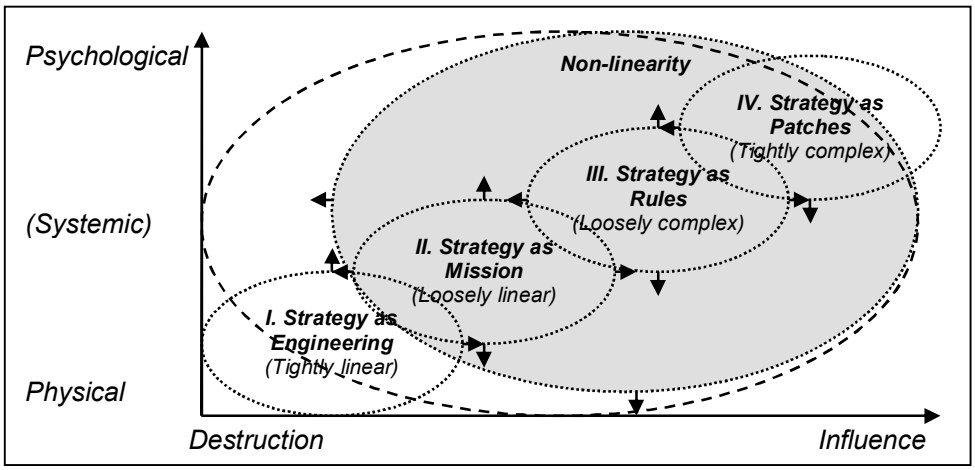

Figure 20: The four various approaches to strategy development

Increased complexity means fragmented information and often the best thing we can do is to let things develop. Thus self-synchronisation, de-synchronisation and a-synchronisation stand for fragmented directions, relinquished control and a multitude of possible options. Only this way is it possible to access information and build up a foundation from which we can exploit emergence. Although the approaches rely on different mechanisms, all emphasise the need to make choices based on always limited information, to stop analysing and start acting even in the case of uncertainty, and to learn and adapt that comes from a constant trial and error process. Strategy understood this way makes it possible to become flexible and fluid "able to move one way while responding to local stimuli and changing direction in response to new information from the environment."[617] In other words, Organic Strategic Ecosystem puts emphasis on people who are able to think as much in terms of how as in terms of what.

14.4.1 Strategy as Mission

The simplest way of finding the winning edge means that our strategy combines the higher rhythm generally found at lower levels, with the lower rhythm generally found at higher level resulting in a vertical and horizontal harmony within the organisation. This self-organisation indicates that general or larger efforts on the highest level become synchronised with particular activities conducted at lower levels. Empowerment in the form of responsibility and commitment throughout the organisation makes it possible to achieve a rhythm that does not pull the organisation apart, resulting in chaos or turns it into a rigid monolith. Freedom of action and

[617] Grove, A. S.: *Navigating Strategic Inflection Points*, Business Strategic Review, Volume 8, Number 3, 1997, p. 11-14; Markides (1999), p. 61, Markides, Costas: *Best Practice, Strategy in Turbulent Times,* Internet, accessed 16. 11. 2006, available at www.tiberius.ro/enter/BestPractice/4BestPractice.pdf (quotation ibid.).

freedom of execution successfully combine subordinate initiative with superior intent. Whereas the superior's intent guides as it describes broadly the *what*, the subordinates' actions realise the intent as best as possible since they stand for the *how*. Consequently, effectiveness expressed by *what* and efficiency expressed by *how* overlap and result in synergy. The process is similar to the notion of evolution since it uses the mechanisms of long jumps and adaptive walks in parallel. Whereas the superior's intent describes the region in broad terms, the subordinates' actions aim at finding both path and peak within the region. In case the subordinates discover high peaks within the region, the inherently flexible relationship throughout all levels allows for a quick readjustment. Self-synchronisation also means that orders are not orders in a linear, classical and rigid way. The subordinates have the right to question the feasibility of the mission if they feel that the superior's ideas are not in accordance with the existing situation or no adequate resources are available. However, after an agreement is reached on what should be achieved the superior has every right to expect the mission to be carried out. This way it becomes possible to minimise a loss of cohesion in the overall effort. Coupling bottom-up initiative with top-down intent enables military organisations to adapt to changing circumstances.[618] Strategy as mission reminds us that strategy development must capitalise both on elements of deliberate planning, and learning and adaptation. Strategy development comes as the result of a dialectic process "generating both disorder and order that emerges as a changing and expanding universe of mental concepts matched to a changing and expanding universe of observed reality."[619] This dialectic process enables the organisation to dwell successfully at the edge of chaos facing no clear boundaries, a predictable opponent or a future for which it can plan.

14.4.2 Strategy as Rules

As the situation becomes increasingly non-linear we must further lessen our approach to strategy development in terms of ends/means rationality. Only this way will it become possible to gain an even higher level of flexibility. Earlier we mentioned that the Third Wave stands for complex challenges and asymmetric warfare. In such warfare the emphasis is on simplicity, organisation and proper timing. In other words, nothing is more important than moving quickly, taking advantage of emerging opportunities and rapidly cutting losses.[620] Asymmetric warfare is extremely fluid in which a simple focus aimed at increasing flexibility is more useful than any overly detailed and difficult-to-revise plan. Although uncertainty is associated with lack of prediction, it also means abundance of opportunities that can be captured, exploited, or dropped should they fail to develop accordingly. Increased flexibility comes from a few critical strategic processes guided by a handful of rules that can define directions without confining them. They delineate only a few parameters within which we try to keep pace with the flow of opportunities. Simple rules enable us to screen and exploit opportunities and allocate resources to areas in

---

[618] Boyd (1986), pp. 66-79.

[619] Mintzberg (1987), pp. 69-70; Mintzberg/Waters, pp. 271-272; Quotation in Boyd, John: *Destruction and Creation,* September 3, 1976, Internet, accessed 22. 03. 2005, available at www.belisarius.com/modern_business_strategy/boyd/destruction/destruction_and_creation.htm.

[620] Wylie, pp. 57-64.

which they are the richest.[621] Strategy as rules indicates that similar to guerrillas the organisation itself is *the* strategy as it follows the velocity of emerging, colliding, splitting and declining opportunities. The emphasis points towards mobility, modularity and scale as displayed for example by a Chinese folk rhyme drawn up by Mao and Zhu: "[When the] enemy advances, we withdraw, [When the] enemy rests, we harass, [When the] enemy tires, we attack, [When the] enemy withdraws, we pursue".[622] A strategy based on simple rules addresses best the nature of asymmetric warfare, which cannot easily be explained by traditional notions since "any form of unstructured raiding qualifies".[623] Simple rules stand for constantly evolving strategies that are normally considered unattractive in traditional terms. However, in a dynamic and continuously changing environment a strategy based on simple rules can better seize unanticipated and fleeting opportunities should circumstances change. They not only provide for a *just sufficient* structure, but can also better capture and exploit the best regions in the space of possibilities. Simple rules help us define processes, boundaries, priorities, timing and exit should efforts fail to succeed:

- *Process-rules* – describe the way key features are executed in order to keep everything sufficiently organised to seize emerging of opportunities.
- *Boundary-rules* – help define which opportunities are within or outside our focus. A quick check of such rules helps sort through emerging opportunities as within the boundaries everything that looks promising can be pursued.
- *Priority-rules* – help rank the opportunities accepted in order to allocate precious resources. They help us profit from nascent and highly attractive niches.
- *Timing-rules* – set the rhythm of key processes and help become synchronised with the best opportunities in order to move quickly towards new ones should they emerge.
- *Exit-rules* – make possible to scan emerging, converging or more promising niches and help us pull out from opportunities should they fade.[624]

Strategy as simple rules does not indicate that objectives are useless, but in a constantly changing environment learning from experience often makes more sense than pursuing predefined objectives that are either inappropriate or cannot be met. Simple rules often grow out of experience and mistakes. They might often exist already in some implicit form until they become explicit, and extend into stated objectives and desired effects. Although simple rules can provide for flexibility, we should never forget that in a dynamic and constantly changing environment such as war, it is impossible to predict how long an advantage lasts.[625] Due to the frictional, chaotic and complex reality of war it is very difficult to deliver timely, concise and appropriate objectives that can address the continuum of events. Unlike objectives, rules do not focus on static states, but by going better with the flow of events they can help find opportunities

---

[621] Brown/Eisenhardt, pp. 32-33; Eisenhardt, Kathleen M.: *Has Strategy Changed?* MIT Sloan Management Review, Winter 2002, pp. 89-91; Grant, Robert M.: *Contemporary Strategy Analysis, Concepts, Techniques, Applications,* Blackwell Publishers, 2002, pp. 516-518.

[622] Quotation in Hammes, p. 46.

[623] Luttwak, pp. 152-157 (quotation p. 152).

[624] Eisenhardt, Kathleen M./Sull, Donald N.: *Strategy as Simple Rules,* Harvard Business Review, January 2001, pp.107-112.

[625] Katheleen/Sull, pp. 112-115; Mintzberg, 1989, pp. 25-42.

more effectively. It is commonplace to state that military operations are often conducted under circumstances in which the amount of available information can become zero. However, even in such cases commanders must provide guidance to subordinates. For this reason three simple rules are often proposed such as “capture the high ground, stay in touch and keep moving”.[626]

14.4.3 Strategy as Patches

Organic Strategic Ecosystem depicts war as a hard, conflict-laden task in which many factors interact as the result of internal and external constraints. In the case the amount of constraints is extremely high we face a very rugged landscape that does not allow for finding good peaks. In such landscapes new opportunities can always open up, sometimes converge, occasionally explode or just fade away. Consequently, the match between strategic directions and emerging opportunities constantly falls out of alignment. Finding the optimal solution in the form of desired effects is very difficult as there are many possible optima in the space of possibilities. However, we learned that conflicting evolutionary strategies are both distinct and modular since they can stand either alone or constantly re-map onto evolving opportunities.[627] Under such circumstances strategy development resembles similarities with patches in a quilt in which the quilt equates with the effects landscape as a whole, and the patches represent various regions. Whereas in the traditional top-down approach strategy is defined by the entire quilt, emergence indicates optimisation first within the patches themselves. Although patches do not overlap, across their boundaries there are couplings in the form of epistatic interactions. Due to the underlying dynamism any selfish optimisation deforms the surface of other regions. A good solution in one patch might help solve problems in some of the adjacent patches. By means of constant learning and adjustments the patches can eventually gain the right size and settle down exactly on the winning edge poised in the transition between the two extremes, order and chaos. Thinking in terms of patches reminds us that whereas a single focused and carefully planned top-down strategy *freezes* into rigid and poor compromise solutions, an exclusively bottom-up emergent strategy *churns* chaotically.[628] Despite the errors made during the process of selfish optimisation, finding the optimum patch size equals finding the right strategic direction. Finding the right effects and exploiting them comes as a result of mutual and constant adjustments. Aggregate *patchwork* strategies seem to be valuable for two reasons. They make it possible to achieve good compromise solutions under conflicting constraints, and also help track moving peaks very well should the environment change quickly.[629]

14.4.4 Importance of Means

Organic Strategic Ecosystem indicates that success in war comes as a result of a phase transition in which we do not settle into a stable equilibrium or fall entirely apart. Victory in war requires a mix of strategies that are rigid enough to organise change, but not too rigid to prevent

---

[626] Quotation in Snowden, p. 19.

[627] Brown, Shona L./Eisenhardt, Kathleen M.: *Competing on the Edge, Strategy as Structured Chaos,* Harvard Business School Press, 1998, pp. 226-231.

[628] Kaufmann/Macready, pp. 26, 36-41.

[629] Kaufmann, Stuart A.: *Technology and Evolution, Escaping the Red Queen Effect,* The McKinsey Quarterly, Number 1, 1995b, pp. 127-129; Kaufmann, Stuart A./Lobo, José/Macready, William G.: *Optimal Search on a technology landscape,* Journal of Economic Behaviour & Organization, Volume 43, 2000, pp. 141-143, 162-164.

change. War as a complex adaptive system indicates that often the central challenge in strategy development is to manage change. Thus we must always be prepared to accept rapid and unpredictable changes that require the emergence of various semi-coherent strategic directions. Friction, chaos and complexity indicate that accepting surprise, making moves, observing the results and continuing with the ones that seem to work are inherent features of war. There is simply too much going on, which does not allow every move to be orchestrated from the top, but often require uncontrolled and parallel actions. Strategy development must happen both at the top at headquarters and below at the front lines. According to traditional measures such an approach means short-term inefficiency based on duplication and misfit. However, addressing the challenges posed by a complex adaptive system requires strategies that are not based exclusively on causal assumptions. They must be built as much by top-level competence as by empowered individuals on lower levels who rely on expanded access to local information. The dynamic interaction with the enemy requires that we eliminate unnecessary constraints. This way we are able to exploit to our advantage the increased uncertainty and complexity that are normally associated with military operations.[630] Success and failure often rest on the shoulders of junior personnel down to the lowest level. By being closest to the events they have to make the right decision at the right time without any direct supervision. This however, requires an atmosphere that promotes agility, information sharing and peer-to-peer relationship in which everyone is empowered to do what makes sense. Thus we need to redefine the individual, the relationship between the individual and others, and between the individual and the organisation. This way it becomes possible to successfully allocate responsibilities and resources. The particularity of time, place and the task, defines who takes charge since empowerment means greater bandwidth of actions including even multi-tasking. Organisations can best take advantage of fleeting opportunities by making the most of available resources. Although such strategies are not optimal for accomplishing pre-defined objectives and desired effects all of the time, they can deliver more innovative solutions to problems at hand at any given time.[631] However, seeing war as an Organic Strategic Ecosystem does not mean that there is no longer a distinction between those who lead and those who are led. Leadership will still play an essential role, but "instead of fusing individual into a mass through the suppression of their individuality and the contraction of their thought, the lead … only has effect, lightning effect, in proportion to the elevation of individuality and the expansion of thought. For collective action it suffices if the mass can be managed; collective growth is only possible through the freedom and enlargement of individual minds. It is not the man, still less the mass, that count; but the many."[632] Regarding cause-and-effect relationships in war "bad means deform the end, or deflect the course thither"; therefore the only thing left possible is to acknowledge that in

---

[630] Brown/Eisenhardt, pp. 7-15; McGill/Slocum, pp. 85-86.

[631] Alberts, David S/Hayes Richard E.: *Power to the Edge, Command and Control in the information Age,* CCRP Publication Series, June 2003, pp. 5-6, 175-177, 179-200, 213-222, 223-231; Krulak, Charles G. (Gen.): *The Strategic Corporal: Leadership in the Three Block War,* Marines Corps Gazette, Volume 83, Number 1, January 1999, Internet, accessed 16. 08. 2005, available at www.au.af.mil/au/awc/awcgate/usmc/strategic_corporal.htm; Fast, William R.: *Knowledge Strategies: Balancing Ends, Ways, and Means in the information Age*, in: Neilson, Robert E. (ed.): *Sun Tzu and Information Warfare*, *A collection of winning papers from the Sun Tzu Art of War in Information Warfare Competition*, National Defense University Press, 1997.

[632] Quotation in Liddel Hart (1938), p. 356.

complex situations “if we take care of the means the end will take care of itself.”[633] In a similar fashion also Helmuth von Moltke emphasised that “[i]n war it is often less important what one does than how one does it.”[634]

[633] Quotation in Liddel Hart (1938), p. 357.

[634] Quotation in Howard, Michael*: The Influence of Clausewitz*, in: Clausewitz, p. 33.

15 Command and Control Alternatives

15.1 Consequences of Evolutionary Biology

The previous chapters can be seen as a technical argument in which we used certain properties of biological evolution to understand the internal working of a complex adaptive system. Our conclusion was that effects-based operations conceptualised in the framework of the Organic Strategic Ecosystem require a fundamental shift in the way we think about strategy development and take strategic actions. This conceptualisation forces us to acknowledge that despite our best intentions, the achieved effects do not always represent a global optimum. Problems of unclear causality and lack of prediction cannot be solved by an allegedly better or more superior way. Thus unpredictability together with the frictional, chaotic and complex reality of war will remain valid factors in any kind of future military operations. Variability of performance is not a sign of failure that can be eliminated. It is an inherent feature of co-evolution and also that of war.[635] Consequently in this chapter we expand further on the biological analogy and attempt to make certain generalisations in terms of command and control based on organic arguments.

15.1.1 Circular Causality and Cybernetics

Organic Strategic Ecosystem helps us conceptualise war as a conflict laden task in which we always have to deal with conflicting constraints. This approach however, makes it very difficult to strive towards predefined objectives and desired effects. War perceived as a complex adaptive system indicates that deductive thinking aimed at detecting clear causality only narrows options and does not address attributes such as emergence and self-organisation. Consequently, we extended the traditional top-down approach to strategy development in order to address those bottom-up possibilities that come as the result of a continuous co-evolution with the enemy. For this reason we proposed three additional approaches to strategy development. Strategy as mission, strategy as rules, and strategy as patches indicate a self-organising and emergent process that requires constant top-down and bottom-up adjustments. Thus Organic Strategic Ecosystem as framework for conceptualising war not only profoundly influences the way strategy should be approached, but implies further consequences in terms of command and control, and regarding the meaning of military effectiveness. The principle of control has a strong mechanical connotation and assumes tight coupling among the constituents. Control means that the manipulation of one of the constituents in all its freedoms makes it possible to influence all other constituents indirectly. Unfortunately, the structural analysis showed that in a complex adaptive system there are both tight and loose couplings. Attempts to find out precisely the way feedback routes are often difficult if not impossible, since any feedback loop can result in endless combinations. Effects have a dual nature and can act as causes to further effects, which indicate that the information contained can occasionally cross its own path. However, if something can be seen both as a cause and an effect, rationality is up for grabs and we face a paradox. This is the very reason why complex adaptive systems can produce occasionally counterintuitive behaviour.

---

[635] Macready, WilliamG./Meyer, Christopher: *Adaptive Operations, Creating Business Processes That Evolve,* in.: Clippinger III., John H.: *The Biology of Business, Decoding the Natural Laws of Enterprise,* Jossey-Bass Publishers, 1999, pp. 186-187.

Although such systems behave over a long period of time dependably and reasonably, in a sudden they can equally show all sorts of surprising and unexpected effects. Very simple causes on the bottom can produce extremely complex effects at the top. We detailed earlier that the traditional military approach equates waging war with managing war despite the fact that we have little to say on most relationships in terms of causality. The frictional, chaotic and complex reality of war points towards emergence and indicates that war has its own dynamic, and often does what it wants. In other words, when facing complex adaptive systems we often assume more oversight than we really have and more than we ever will have, regardless the technological achievements.[636] In war we have to expect non-intuitive traits in which effects can become disproportional to causes since a small variation in inputs can produce a huge variation in outputs. Unfortunately, as soon as we have to deal with feedback little can be deduced about its character merely by studying it. The effects landscape can be seen as a generic model of war that attempts to visualise massive and simultaneous interactions of various constituents. The model also addresses the intricacy of causal relationships since anything that registers input and generates output is interpreted as input by a neighbour. Evolution seen through the processes of effectiveness and efficiency indicates that we need to develop the ability to adjust internal links so that they fit external demands over time. Thus biological evolution and war are nothing more than a set of complex and dynamic interactions. The analogy between them makes it also possible to identify the hierarchy of codes most complex adaptive systems possess. The first is the general drive for survival, the second is to achieve maximal flexibility, and the third is to identify useful strategies.[637] However, in the case of war we suggest a fourth code, which is finding useful command and control practices to make strategies work.

15.1.2 Command as Force Multiplier

It is undeniable that superior command, which properly takes the frictional, chaotic and complex reality of war into account, serves as force multiplier. It is equally true that technology can enhance command performance, but successful command does not come as a direct result of advanced technology.[638] Commanders through all waves have exercised various sorts of command practices in an attempt to address the difficulty posed by spatial and temporal limitations. In a simple version such limitations allow for two possibilities: commanding all of the troops part of the time, or commanding part of the troops all oft the time. Another difficulty of commanding comes from the problem of information dissemination. As the chain of command grows longer, its value suffers both from the number of stages and from standardisation attempts. The result is that information can often be so profiled that it borders on meaninglessness. Heaving these two extremes and the problem of information, successful commanders have realised that it is always possible to defeat the enemy, but never uncertainty. They knew that the greater the uncertainty the better it is to avoid tight control over subordinates. Instead of trying to control war's frictional, chaotic and complex reality they accepted unpredictability as inevitable and tried to make the best out of the situation. For this reason the

---

[636] Kelly, Kevin: *Out of Control, The Rise of Neo-Biological Civilisation*, Addison-Wesley Publishing Company, 1994, pp. 121-127, 324-330.

[637] Ibid., pp. 389-403.

[638] Wallace, William S. (Lt. Gen.): *Network Enabled Battle-Command*, Military Review, May-June 2005, pp. 2-5; Whitehead, Stuart A. (Col.): *Battle Command, Toppling the Tower of Babel*, Military Review, September-October 2005, pp. 22-25.

battle of Jena fought in 1806 can serve as a good example. Although Napoleon achieved one of his biggest victories he "had known nothing about the main action that took place on that day; had forgotten all about two of his corps; did not issue orders to a third, and possibly to a fourth; was taken by surprise by the action of a fifth; and, to cap it all, had one of his principal subordinates display the kind of disobedience that would have brought a lesser mortal before a firing squad."[639] It appears that Napoleon, one of the biggest commanders of all time was not only able to tolerate a high degree of uncertainty and still exploit the situation, but also his subordinates were willing to accept responsibility and self-initiative. A complex adaptive system such as war requires a large safety margin in order to ensure that mistakes do not accumulate and develop into disasters. Similar to the trial-and-error mechanism of biological evolution, waging war equals making blunders and learning from them as best as possible. Emergence and self-organisation not only mean that planning should often not go further than the first encounter with the enemy, but indicate that the amount of information needed to act at any given level be reduced to a minimum.[640]

15.1.3 Handling Uncertainty

Whatever the command practices employed humans have always attempted to address the pervasive temporal and spatial uncertainty of war and the problem of insufficient information. Thus we propose to distinguish between four possibilities that come as a result of the combination of spatial and temporal factors and indicate the possibilities of commanding *all* of the forces *all* of the time, *all* of the forces *some* of the time, *some* of the forces *all* of the time, and *some* of the forces *some* of the time. The four possibilities are *command-by-direction*, *command-by-plan*, *command-by-influence* and *command-by-evolution*. The first three possibilities can be described as follows:

- *Command-by-direction* – most commanders found that despite being positioned on a vantage point from where they directed the battle, spatial limitations often rendered them to observers rather than commanders. In order to offset this limitation they occasionally attached themselves to that particular element of their forces, which they assumed to be decisive. In the case the situation was favourable they also moved from one unit to the other. Although they prioritised uncertainty depending on the unfolding dynamics of war, they commanded only some of their forces some of the time.
- *Command-by-plan* – stands for comprehensiveness and an attempt to plan everything in advance and as detailed as possible. It is a highly centralised approach that emphasises rules and procedures. Predefined plans guide actions that both promote inflexibility and address only the strategic/operational levels of war. Commanders focus on certain enemy centres of gravity in order to achieve victory. This approach attempts to centralise and structure uncertainty in a top-down deductive hierarchy aimed at exploiting causality. However, this approach has also limitations since it makes it possible to command all of the forces only some of the time, mostly before the engagement with the enemy.
- *Command-by-influence* – means that only the outline and the minimum goals are stated in advance. This approach distributes uncertainty in order to influence subordinates behaviour, but not control events. Instead of a detailed and difficult to revise plan the commander's

---

[639] Creveld, Martin van: *Command in War*, Harvard University Press, 1985, pp. 4, 56, 75, (quotation p. 96)

[640] Ibid., pp. 121, 145-146.

intent serves as a general guidance and assumes lower-level initiative exploiting local knowledge. The approach relaxes decision thresholds and promotes semi-autonomous actions down to the lowest level. However, despite its flexibility this sort of command tackles uncertainty only at the tactical level. It allows for adjustments downwards to changing battlefield conditions, but does not promote change upwards, which is so essential in a continuous co-evolutionary process. Consequently, this approach has also limitations since it allows only to command some of the forces all of the time.[641]

We can see that the three approaches do not cover the full spectrum of command possibilities and can be regarded as variants of a top-down, one-way methodology. The biggest difference among them lies in the way higher-level interference is relaxed in terms of lower-level actions. Although we can see a gradual change towards flexibility both regarding the superior's requirements and the subordinates' actions, none of them promotes mutual learning and constant adaptation. Oddly, even command-by-influence, which can be seen as the most flexible among them allows learning from the enemy rather than from the subordinate. Based on insights coming from the Organic Strategic Ecosystem we suggest a fourth approach. This most organic approach makes it possible not only to live with, but also exploit uncertainty. Evolution requires constant learning and adaptation since in a dynamically changing environment bottom-up information can often be more useful then top-down intent. However, before detailing the fourth option, which is command-by-evolution it is of utmost importance to analyse evolution in terms of command and control.

15.2 Organic Command and Control

In order to conceptualise war as a complex adaptive system we draw on an analogy found in evolutionary biology. Any conduct of military operations that takes the frictional, chaotic and complex reality of war into account requires that we understand the mechanism of biological evolution. Similar to the evolution of biological species, the effects landscape indicates effects-based operations to be a phenomenon that seethes and bubbles as a result of constantly changing disorderly processes. In biological terms war is an open system that continuously evolves. Assumptions regarding direct causality, linear deduction, and analytical categorisation do not address the full band-with of possible perturbations. Consequently, we can say that "in war … even the mediocre is quite an achievement."[642] To paraphrase Clausewitz war is *evolution by other means* as it deals with living and animate human beings. He also pointed out that we must "always leave a margin for uncertainty, in the greatest things as much as in the smallest."[643]

15.2.1 Phrase vs. Compound Word

In the case we want to trace back the origins of the term *command and control* also known as *C2*, we should go back as early as World War II. Although there is no clear evidence that the

---

641 Czervinski, Thomas J.: *Command and Control at the Crossroads*, in Czerwinski, pp. 213-220.

642 Schmitt, John F.: *Command and (Out of) Control: The Military Implications of Complexity Theory* in: Alberts/Czerwinski; Quotation in Creveld (1985), p. 13.

643 Quotation in Clausewitz, p. 97.

term was already used, we can find an increased number of various expressions closely resembling the current meaning. Over the years the term evolved in a way that now it can be treated both as a phrase and a compound word.[644] Nowadays there is an abundance of definitions indicating that command and control is well-entrenched both in military doctrine and vocabulary. We demonstrated earlier that despite references to complexity theory and complex adaptive systems the way Western armed forces understand strategy development is still very much top down, deductive, analytic and linear. This however, does not take war's emergent and self organising attributes into account. Unfortunately, the same is true for command and control. As an example Joint Publications 1-02 defines C2 as "[t]he exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission."[645]

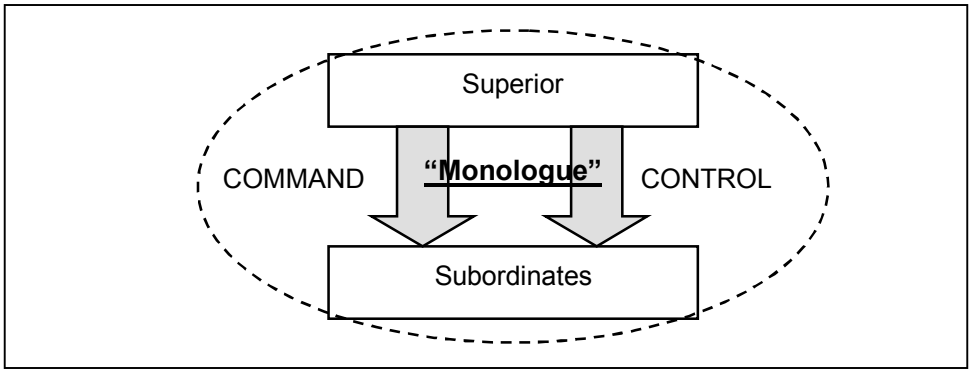

Figure 21: Command and control as "monologue"

According to the definition and as depicted in Figure 21, command and control is understood as a one way process flowing exclusively from top to down. War as a complex adaptive system stands for polarities to manage, rather than problems to solve. Thus similar to strategy development polarity must also be included in the way we understand command and control. Although the current unidirectional understanding can best be described as a monologue, a close and separate examination of the two constituent words makes it possible to discern polarity in the form of a dialogue. Approaching command and control this way enables us to marry command-by-evolution with the proposed Organic Strategic Ecosystem.

15.2.2 From Monologue to Dialogue

The inappropriateness of a top-down understanding of command and control becomes clear if we look at the meaning of these two terms. Although command and control can both be seen as a phrase and a compound word, for a better analysis we suggest treating it as the latter.

---

[644] Sproles, Noel, Dr.: *Dissecting Command and Control with Occam's Razor or Ask not what "Command" and "Control" means to you but what you mean by "Command and Control"*, Australian Defence Force Journal, No. 155, July-August 2002, pp. 19-26.

[645] Quotation in *Joint Publication 1-02*, p. 101, For figure see Schmitt.

Whereas command refers to the full range of human innovation and flexibility needed to solve unexpected and complex problems, control stands for a set of regulated procedures, which restricts flexibility and excludes alternatives. In normal English usage command can also be understood as the ability to readily call forth or evoke. Thus command also refers to creativity, which is probably the most important requirement both in terms of evolution and war. Creativity emphasises the importance of learning and adaptation that points towards emergence and self-organisation, which we identified as the most important attributes of complex adaptive systems. Although creativity is necessary for command, it is not sufficient in itself. It requires another characteristic such as will, which stands for motivation and opportunity. Control indicates either direction or restraints that emphasise proportion and appropriateness in terms of procedures, policies and guidelines aimed at certain end-states. [646]

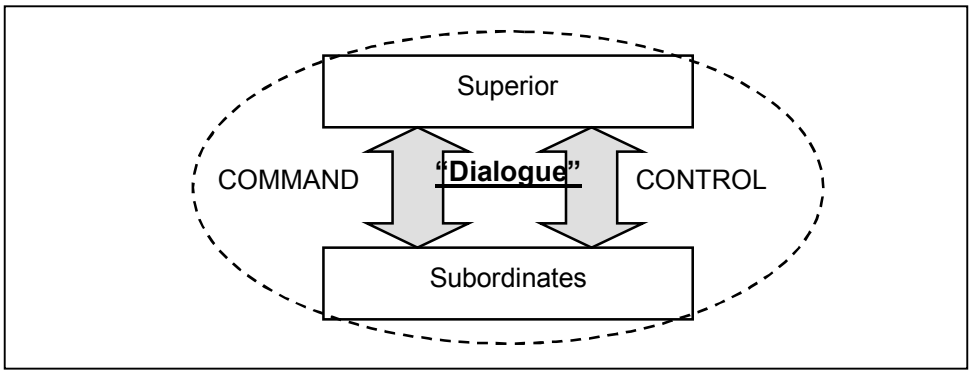

Figure 22: Command and control as "dialogue"

Thus the two end-poles within which command and control activities take place can be defined by the creative expression of human free will on the one hand, and various structures and processes on the other. Having these two end-poles the main functions we can discern are as follows:

- *Command* – means novel solutions to emerging problems since it provides for starting conditions that indicate a diligent purposefulness. It is the act of expressing will creatively in order to accomplish a mission. Command stands for creating new structures and processes that allow for unanticipated changes to plans.
- *Control* – makes it possible to express human will creatively in order to manage emerging problems and maximise the chance for a good-enough solution. It provides for the framework in the form of structures and processes. In sum, control stands for monitoring and in the case it is needed, adjusting existing structures and processes. [647]

The two end-poles suggest that similar to the three approaches to strategy development, command and control can also be perceived as a mutually adjusting top-down and bottom-up process. As depicted in Figure 22, command and control are not exclusive alternatives, but fundamentally interdependent and interrelated perspectives. They stand for the fact that

[646] Pigeau, Ross, Dr./McCann, Carol: *Re-Conceptualising Command and Control*, Canadian Military Journal, Spring 2002, pp. 53-56.

[647] Gove, pp. 455-456, 496-497.

traditional military hierarchy emphasising a formal differentiation between superior and subordinate can often brake down as a result of unfolding situations and changing circumstances. We do not indicate that there is no reason to differentiate between those who lead and those who are lead. However, successful command and control requires a mutual adjustment in order to find the narrow edge of chaos and dwell there successfully.

15.2.3 Organic Approach Documented

It appears that *MCDP 1 Warfighting* catches best the essence of command-by-evolution. It recommends an organic, evolutionary approach by emphasising the importance of implicit communication. Mutual understanding, coupled with a minimum of key phrases, the courage to anticipate each other's thoughts is the most efficient way to successfully address the co-evolutionary character of war. A constant dialogue between superior and subordinates creates an atmosphere that enables constant learning and adaptation, and promotes the readiness and willingness to learn throughout the ranks. Command-by-evolution means that bottom-up variety and rapidity leads normally to confusion and disorder if it does not accord with top-down harmony and initiative. However, it also indicates that top-down harmony and initiative without bottom-up variety and rapidity, can often lead to rigidity and non-adaptability. Whereas unbridled creativity can often lead to chaos, over-control can result in individual de-motivation. Simply put, command-by-evolution means that we become able to gain quickness and security. It does not stipulate that only commanders on the top exercise command and control functions. As emergence and self-organisation indicate, command and control is as much a top-down as a bottom-up process.[648] In other words, every human is inherently able to express will and capability in the service of the operation. We also have to take into account that finding the right balance does not always mean finding the *golden middle way*. Dealing with a complex adaptive system such as war indicates that the situation itself defines which side of the polarity must be emphasised in order to address successfully the challenges that come as a result of a continuous co-evolution with the enemy. Command-by-evolution means that we are able to find a "correct balance between encouraging creative command and controlling command creativity."[649] Consequently, we are able to merge structure and process with creativity and will. Only this way becomes possible to address the roiling complexity of war and adjust successfully.

15.3 Command-by-Evolution

Any approach that emphasises centralisation on all levels can de-motivate subordinates to exercise initiative based on changing circumstances and superiors to listen to subordinates carefully. Another danger comes from the reliance on advanced technology that easily allows superiors to bypass subordinates and relegate them to information administrators. Centralised uncertainty means that independence, trust, rapidity in terms of decision-making and taking risk deliberately into account, are suppressed. Unfortunately, these are the very factors without which wars cannot be won. It appears that a top-down, mechanistic and linear approach

---

[648] U.S. Marine Corps: *MCDP 1 Warfighting*, 20 June 1997, pp. 78-79; Boyd, John: *Organic Design for Command and Control*, May 1987, p. 9, Internet, accessed 26. 05. 2005, available at www.d-n-i.net/boyd/pdf/c&c.pdf.

[649] Pigeau/McCann, pp. 56-62 (quotation p. 57).

resembling a monologue does not take into account situations in which commanders must deal with a thinking enemy who reacts and adapts to every move.[650] In order to elaborate on command-by-evolution in detail we approach it from three different angles approaching C2 as *confidence and competence*, *coping and co-evolution*, and *creativity and change*.

15.3.1 C2 as Confidence and Competence

In general we can say that the biggest heritage of the Second Wave in terms of command and control is twofold. The first is a formal separation between those who lead and those who are lead, which is expressed in a strict pyramid-like hierarchical design. The second comes as a result of the first, since it is supposed that those on the top are more important than those serving below. However, war as a complex adaptive system requires that much of command must be delegated to lower levels in order to detect, track and exploit emerging opportunities in a self-organising fashion. Conceptualising effects-based operations as a search process in a landscape assumes that we see war in terms of networks. Consequently, we must become a network ourselves, in which the emphasis shifts towards a horizontal focus. Thus power must be distributed in a lateral way in which each boundary, cluster, and node interacts up to the moment at which we engage with the enemy. We mentioned that it is impossible to control complex adaptive systems; therefore we must refocus from command and control in traditional terms and emphasis confidence and competence. This means that both superiors and subordinates are able to work in an autonomous and asynchronous way in which boundaries are neither fixed nor controlled, but adapt according to the requirements. Thus consensus does not come as a result of a top-down monologue, but as a stop-and-go process that rests on trust and confidence. Both superiors and subordinates know that despite the errors and blunders committed, everybody wants to achieve the right thing. Humans are willing to learn and change views in order to adapt to constantly changing circumstances. Confidence and competence come out of collective experience that helps exercise disaggregated and asynchronous command procedures. Thus information can find its way to those who need it even if they do not want to know it. The effects landscape stands for a constant change with often surprising opportunities that require rapid and immediate actions often carried out in novel ways. Armed forces have to move from a formal and vertical to a more informal and horizontal organisational structure in which the emphasis is on people who tend to become better subordinates and better superiors. Only those can learn from their mistakes who have been allowed to make them.[651] Command-by-evolution takes mission command a step further and assumes that not only subordinates have the freedom to realise the superior's intent, but also the superior is ready to learn and adapt his intent to the battlefield realities that come as the result of a continuous co-evolution with the enemy. This way it will be possible to exploit emergening opportunities nobody could have imagined in advance, but can serve equally well or even better than those, which were planned and formulated in terms of

---

[650] Vego, Milan N.: *Operational Command and Control in the Information Age*, Joint Force Quarterly, Issue 35, pp. 101-103; MacGregor, Douglas A.: *Command and Control for Joint Strategic Actions*, Joint Force Quarterly, Autumn/Winter 1998-99, p. 28.

[651] See also Atkinson, Simon Reay/Moffat, James: *The Agile Organization, From Informal Networks to Complex Effects and Agility*, CCRP Publication Series, May 2005, pp. 172-188; Storr, Jim: *A Command Philosophy for the Information Age: The Continuing Relevance of Mission Command*, in: Potts, David (ed.): *The Big Issue: Command and Combat in the Information Age*, Strategic and Combat Studies Institute, February 2003, pp. 77-93.

desired effects. This two-way process of constant adjustment means that effects are achieved in a way that exploits both effectiveness and efficiency as the two interrelated processes of adaptation.

15.3.2 C2 as Coping and Co-evolution

Command-by-evolution exploits uncertainty in a novel way and calls for freedom and adaptability at all levels. It acknowledges that the frictional, chaotic and complex reality of war requires only general statements to be stated in advance in order to start activities rather than a detailed plan. Thus only guidelines must be laid down in order to put the system into gear. As soon as the co-evolutionary process with the enemy gains momentum, details that cannot be anticipated beforehand will emerge anyway. A good example for emergence and self-organisation was the 1967 Arab-Israeli war in which for the Israeli side "only the first [day] was planned in any detail; the rest was pure improvisation."[652] Israel achieved one of its most stunning victories over its neighbours at a cost of roughly 680 soldiers killed, 2,600 wounded and 15 more becoming prisoners. In contrast, according to various estimates the numerically superior combined Arab forces suffered 21,000 casualties, a further 45,000 soldiers were wounded and 6,000 became prisoners. Confronted by a much larger coalition and facing a three-to-one imbalance of forces, Israel managed to win within six days. A successful mix of surprise, intelligence, guile, gamble, determination and courage backed by a maximum independence of subordinate commanders, mutual trust and appreciation in the form of an implicit brotherhood throughout the ranks resulted in communication and comprehension, which are so necessary for flexibility in war.[653] Israeli units were able both to self-organise and exploit emergent windows of opportunities despite the many blunders they committed during the operations. They probably did not achieve what we would describe as desired effects, but were able to exploit those opportunities sufficiently to be victorious in the end of the day. Command-by-evolution is an organic concept that does not over-emphasise the role technology plays in war. It just reminds us that whatever the level of sophistication of the employed technology, it equally opens up and shuts down possibilities. It is as important to exploit advantages it offers as to understand the limitations it has. The very process of co-evolution indicates the enemy to be composed of intelligent human beings who are always ready to exploit vulnerable niches in order to turn initial disadvantage to their favour. Thus in terms of command-by-evolution and the Organic Strategic Ecosystems, the Western bias that emphasises technology and disregards men stands in sharp contrast to the inherently human character of war.

15.3.3 C2 as Creativity and Change

Conceptualising war in the framework of a complex adaptive system requires seeing command and control in terms of polarity. Even the proposed organic approach allows for conducting command and control functions in a traditional top-down fashion resembling a monologue. The closer we are to the region of stability, the higher their value. However, we must equally take into

---

[652] Creveld (1985), pp. 195-203, 231, 252 (quotation p. 200).

[653] Harbaki, Yehoshafat: *Basic Factors in the Arab Collapse During the Six-Day War*, Orbis, Volume 11, Number 3, Fall 1967, pp. 677-691; Gallois, Pierre: *1967: The Triumph of Vertical Warfare,* Geopolitique, Number 22, Summer 1988, pp. 17-19; Khan, Farzana: *The Arab-Israeli War,* Pakistan Horizon, Third Quarter 1967, pp. 267, 273; For quick statistics see also Wikipedia: *Six-Day War*, Internet, accessed 07. 03. 2006, available at http://en.wikipedia.org/wiki/1967_war.

account that as the dynamics of war unfold the co-evolutionary process with the enemy will shift towards the chaotic area. Consequently, command and control in traditional terms become increasingly vacuous. Approaches attempting to prioritise, centralise or distribute uncertainty cannot cope with all the conflicting requirements and constraints soldiers face. Thus we must both address and take advantage of the emergent and self-organising patterns displayed by war. The most important message of the Organic Strategic Ecosystem is that victory in war requires the harnessing of everyone's intelligence throughout the ranks. It is probably too far to state that if you order a soldier to do something, you have already failed as a leader, but we must acknowledge that people are in general, ready and willing to work well, contribute their ideas and take responsibility. The frictional, chaotic and complex reality of war demands everyone's contribution to solve emerging challenges and crises. Command-by-evolution indicates that self-managed and autonomous teams can come up with smarter solutions to problems and achieve a higher level of adaptability. It acknowledges that the higher the risk, the more we need the commitment and intelligence of everybody. Emergence and self-organisation means that people often get together in order to achieve more and not less. This way they develop a shared understanding and behaviour to take required actions. Strategies developed this way are simpler and more localised. They require a constant search for solutions, which come as a result of intimate and local experience that can turn into system-wide coherence.[654] Although these activities indicate that organisations are able to tolerate a high level of messiness, they can provide for an atmosphere in which freedom and creativity are the driving forces for achieving sufficient local solutions. As the 1967 Arab-Israeli war showed if people can develop trust for each other they also establish an atmosphere that is more creative and forgiving. Consequently, local responsiveness can turn into higher general adaptability and agility.

15.4 March Up-Country

The effects landscape depicts effects-based operations as a migratory process on an imaginary landscape. Based on the interaction with the enemy, the surface always changes and poses a serious challenge both in terms of planning and adaptation. A good example for the combined power of emergence and self-organisation can be found in Xenophon's book. It describes the march of a Greek expeditionary force of roughly 11,000 men fighting its way back from Asia Minor to Greece 2500 years ago. Similar to the effects landscape, the ancient Greeks had to find home in a mostly unknown terrain guided only by local information that required a constant adaptation to changing circumstances and the exploitation of emerging opportunities.

15.4.1 Heading to the Black Sea

After the death of Cyrus who hired them, the Greeks found themselves trapped in a hostile environment. Surrounded by enemies with most of their original generals and officers seized and killed, having no guides to show them the way, and facing unknown territory they managed to reach the Black Sea mostly intact. According to Xenophon 8,600 men of the original 10,700 survived despite the difficulties they encountered, which means a total loss ratio of 20 percent. Emergence and self-organisation were manifest in all of their actions. As an example in book

---

[654] Wheatley, Margaret J.: *Finding Our Way, Leadership for an Uncertain Time*, Berrett-Koehler Publishers, 2005, pp. 64-74.

three Xenophon stated in the beginning of their long march that "let us not … wait for others to come to us and summon us to the noblest deeds, but let us take the lead ourselves and arouse the rest to valour."[655] During their march the Greeks routinely assembled to vote on proposal of their elected leaders, erected boards and councils to debate and discuss issues such as organisational modifications or suitable tactics. Having a flat-enough organisational design and a horizontal rather than a vertical structure, the superiors always marched and fought alongside their subordinates. As Xenophon emphasised "it is right to expect that you should be superior to the common soldiers, that you should plan for them and toil for them whenever there be need."[656] Whereas they achieved maximum physical flexibility by burning all their superfluous equipment before the march, their command flexibility resulted from the ability to compensate for the want of leadership and discipline. However, what made them really lethal is expressed in the explicit encouragement of subordinates to come up with alternatives and suggestions at any time. Xenophon always welcomed bottom-up initiative by assuring subordinates that "if any other plan is thought better than mine, let anyone, even though he be a private soldier, feel free to present it; for the safety of all is the need of all."[657] This adaptability was enforced by an organisational design, which was regarded as a good-enough start. Xenophon emphasised that "for the future, as we make trial of this formation we can adopt whatever course may seem from time to time to be best. If anyone sees better plan, let him present it."[658] As a result, when the Persian commander Mithradates seemed to be superior because of having mounted troops and slingers, the Greeks were able to offset his advantage within a night by establishing similarly equipped troops. They were also willing to use either superior enemy equipment such as Persian arrows, or to innovate and build new ones. If the marching formation they originally choose was not good enough, which became clear as soon as they started to cross rivers, they went over to an even less structured formation that further delegated responsibility down to junior commanders. Another good example for flexibility can be found in a dialogue between Cheirisophus, the senior commander of the Greek army and Xenophon. During a battle with a Persian army, the occupation of a mountain top was seen as crucial and Xenophon offered his commander that "[i]f you choose, then, stay in command of the army, and I will go: or, if you prefer, you make for the mountain top, and I will stay here." Cheirisophus replied by saying that "I leave it to you to choose which part you wish."[659] Thus Xenophon led the Greek forces and when he was reminded by Soteridas, a common soldier, that he was riding on horse back while others had to conduct a forced march, he dismounted and continued to march on foot. On another occasion the generals collectively decided upon a proposition to cross a river. They concluded that although it was a clever alternative its execution was rather impossible, which eventually led them first into the country of the Carduchians and then to Armenia.[660]

---

[655] Xenophon: *Anabasis*, Harvard University Press, 2001, pp. 215-225 (quotation p. 225).

[656] Ibid., pp. 226-231 (quotation p. 231).

[657] Ibid., pp. 232-251 (quotation p. 251).

[658] Ibid., pp. 252-253 (quotation p. 253).

[659] Ibid. pp. 254-279 (quotation p. 279).

[660] Ibid., pp. 280-289; Hanson, Victor Davis: *Carnage and Culture: Landmark Battles in the Rise to Western Power,* Anchor, 2001, pp. 1-5.

15.4.2 Emergence and Self-Organisation

Information was allowed to flow directly upward in an unconstrained way as displayed by an example in book four. By fighting their way through the mountains on one occasion, the Greeks encountered a joint force of Armenians, Mardians and Chaldeans that appeared to be superior in numbers. They were forced to cross a deep and fast flowing river, which was seen as a difficult and dangerous undertaking. The situation came close to a disaster as the Greeks saw a river difficult to cross, enemy troops intended to obstruct their crossing and ready to fall upon their rear. However, by accident two young Greek soldiers discovered a save ford and since they knew that soldiers were allowed to go to Xenophon "whether he was breakfasting or dining, and that if he were asleep, they might awaken him and tell him whatever they might have to tell that concerned the war."[661] They passed the information directly to their superior and this way the cornered and desperate Greeks were able to slide out of the hand of their enemies. Later in Western Armenia, they came under a heavy fall of snow that covered the bivouacked men. The next morning soldiers were reluctant to get up. In order to show example Xenophon was the first to get up and split wood. One by one soldiers got up and also started to split wood, build fires and anoint themselves. On another occasion when they entered the country of the Taochians they nearly run out of provisions and were forced to attack one of the strongholds that was built on a steep hill. Every time when the Greeks attacked they were repulsed by stones rolled down from an overhanging rock crushing the soldiers' ribs and legs. As a result Greek troops sought shelter in the cover of nearby trees. In order to solve the situation and to motivate subordinates, the captains of the companies developed a scheme and led by example. In their run across the stronghold Agasias, Callimachus, Arystonimus and Eurylochus "thus contending … captured the stronghold, for once they had rushed in not a stone came down any more from above."[662] Despite the unknown terrain and hostile countries they marched through, the Greeks could eventually reach the Black Sea. As described in book five they took counsel for themselves in which the generals underwent an inquiry with reference to their past performance, and in case misconduct was discovered, they had to pay a fine.[663] Needless to say that such a bottom-up evaluation of superiors by subordinates stands in sharp contrast with the current top-down one-way evaluation scheme of subordinates by superiors found in most Western armed forces. In other words, they conducted a thorough after action report in order to enhance their effectiveness for the remaining part of their trip to Greece.

15.4.3 From Intelligence and Command to Intelligent Command

The example of the ancient Greeks shows that proper information coming through an emergent and self-organising mechanism can successfully limit, but never eliminate the frictional, chaotic and complex reality of war. Although the fog of war can occasionally be reduced to mist, information will never be complete or absolutely perfect. In war we always deal with the likely rather than the true. More information might create more predictability, but the bigger its amount the greater the uncertainty, hence the unpredictability it contains. In any case we must deal with war's inherent unpredictability that often hinders both the formulation and achievement of desired effects. In the last two decades we witnessed a steep increase in the performance of

---

[661] Ibid., pp. 291-317 (quotation p. 317).

[662] Ibid., pp. 318-361 (quotation p. 361).

[663] Ibid., pp. 362-379, 447-465.

information technologies Western armed forces can field. However, the tempo of operations and the demand for making split-second decisions has also grown. It appears that the weakest link in this process is still the speed at which humans make decisions, which has not changed much since the age of Xenophon. Another problem we have to accept is that despite the amount of available information, it is often "trivial in quality and overwhelming in quantity."[664] Thus contemporary commanders are confronted with two sorts of uncertainty in terms of information:

- The first type is due to the lack of accurate, useful and timely information, which has always been part of the business of war.
- The second type is due to the overwhelming amount of information since advanced technologies can both collect and communicate nearly anything and everything.[665]

Asymmetric wars are mobile in which both the deployment and employment of forces will frequently change. Official channels of command and control can brake down and superiors will often be unable to guide their subordinates who have to carry out actions with little time to assess and prepare. As the ancient Greek example shows, fleeting and unique military situations require a constant adaptation based on local information harnessing individual initiative and responsibility. Information must often be generated and exploited on a local level in order to achieve effects that might not always be predictable, but are good-enough to become both effective and efficient at the same time.

---

[664] Ferris, John/Handel, Michael I.: *Clausewitz, Intelligence, Uncertainty and the Art of Command in Military Operations*, Intelligence and National Security, Volume 10, Number 1, pp. 40-49 (quotation p. 49).

[665] Ibid., p. 52.

16 Military Effectiveness

16.1 Battles, Wars and Victory

The preceding chapters detailed the consequences of a conceptualisation of war as a complex adaptive system in terms of strategy development, and command and control. This chapter addresses such a conceptualisation from a military effectiveness point of view. As the Supreme Allied Commander Transformation stated in an interview, the ability to assess effects is seen as a significant detriment in military operations to come. Thus according to him we must become able to "assess effects as opposed to counting things, today we count things." [666]

16.1.1 Effectiveness and Causality

Not only achieving desired effects is important in the conduct of effects-based operations, but so is getting feedback. However, before proceeding further it is useful to elaborate more on the example of the ancient Greeks. The most important message of Xenophon's book, is that mastering the challenges posed by war requires more than an exclusive focus on one particular area in the continuum of war. Waging war does not mean that on occasion we cannot influence the enemy and achieve psychological effects. Xenophon was also successful in conducting psychological operations such as disfiguring the bodies of fallen enemies.[667] Nevertheless the Greeks took equally into account that war is a deadly contest in which they must be prepared as much to destroy and defeat the enemy by the application of brute force, as to influence him through various coercive means in order to come to favourable terms. Organic Strategic Ecosystem emphasises war as a dynamically evolving phenomenon rather than a single instantaneous event. Thus war is seen as a series of dynamic interactions in which the belligerents attempt to gain advantage over time that might either accumulate or reverse into balance again. War happens in the form of interactions of various sizes until one belligerent is decisively defeated or decides to surrender. We made it clear earlier that in this process it is the product rather than the sum of interactions that decides on the outcome. Wars can last until the bitter end or stop before total destruction.[668] In either case the relative ability to learn and adapt expressed as military effectiveness appears an important attribute and refers to a gap in operational capabilities over time. Consequently, military effectiveness is a crucial factor and deserves a close examination. Regardless whether it is approached in quantitative or qualitative terms, we have to deal with a multitude of factors that are very difficult to calculate. Any attempt to describe it means that we limit our attention to certain features and do not focus on the full range of possibilities. The results gained reflect as much practical benefits as a certain analytical convenience. Although they always contain a set of indicators that appears to be strongly interrelated, the insights gained are often narrow and highly inconsistent. War seen as a complex adaptive system means, that attempts to get a grip on military effectiveness face the

---

[666] Quotation in NATO Speeches: *Press Briefing by Adm. Giambastiani SAC ACT on 12. 10. 2003*, Internet, accessed 21. 02. 2006, available at www.nato.int/docu/speech/2003/s031112b.htm.

[667] Xenophon, p. 263.

[668] Smith, Alistair: *Fighting Battles, Winning Wars*, Journal of Conflict Resolution, Volume 42, Number 3, June 1998, pp. 301-305.

problem of no clear causality, which can only be lessened, but never eliminated. Even if we can establish a causal link between military effectiveness and the variables it explains, the only possible way to do so is by restricting the dependent variables and more clearly defining what sort of effectiveness we mean. Organic Strategic Ecosystem indicates that events in war can have both systematic and accidental causes, which stand for identifiable causes and effects, and phenomena humans cannot explain or understand based on analytical rationality. The result being that any judgement regarding effectiveness colours as much the view of events as limits the attention. Thus judgements always include certain aspects and exclude others. Assumptions regarding military effectiveness are as much permissive as they are deterministic/heuristic. Measures of military effectiveness often reflect the sum of individual aggregates rather than collective characteristics. The inherent complexity of those characteristics is responsible for the problems that make any description and assessment of military effectiveness very difficult. Although military effectiveness is often seen as an implicit, unconscious phenomenon taken mostly for granted, it cannot be addressed directly. Similar to any abstract concept, it is not a concrete thing, but must be inferred from other clues. The more we move towards psychological effects the harder it becomes to disentangle indicators and variables from each other. Consequently, any attempt to address military effectiveness has to deal with collective attributes.[669] All these problems mean that assessing military effectiveness is context-dependent and always influenced by certain cultural and societal attributes. According to the social wave-front analysis the way we make wealth influences the way we wage war, which implies that the low effectiveness of some armed forces in the second half of the 20th century were mostly due to societal and cultural determinants. Indicators can include peculiarities such as over-control in the form of the rigidly centralised command structure, the officer corps's contempt for ordinary soldiers and its distrust of a capable NCO corps. Impact of such societal and cultural deficiencies is often seen as responsible for the humiliating defeats Arabic forces suffered at the hand of Israel.[670]

16.2 Fighting Power

Effects can be achieved on the strategic, operational and tactical levels of war. Whereas psychological effects refer mostly to the strategic level, systemic effects address the operational, and physical effects the tactical level of war. We also detailed that lower-level effects are easier to achieve than higher order follow-on effects. Physical effects mostly in the form of destruction are relevant only to the extent they contribute to changes in enemy behaviour; therefore they are mostly of secondary importance. Psychological effects are very difficult to achieve due to the inherent black box of the mechanism involved. Thus military effectiveness can theoretically be measured on every level of war. However, we suggest to examine the issue of military effectiveness on the operational level where it can be expressed by the concept of *fighting*

---

669 Liddel Hart, B. H.: *The Ratio of Troops to Space*, Military Review, April 1960, p. 9; Elkins, David J./Simeon, E. B.: *A Cause in Search of its Effect, or What Does Political Culture Explain?*, Comparative Politics, January 1979, pp. 127-137; Schnaubelt, Christopher M.: *Can The Military's Effectiveness in the Drug War be Measured?* The Cato Journal, Volume 14, Number 2, Fall 1994, Internet, accessed 12. 05. 2006, available at www.cato.org/pubs/journal/cjv14n2-5.html.

670 Harkabi, Yehoshafat, pp. 685-691; Lewis, Bernard: *The Arab-Israeli War, The Consequences of Defeat,* Foreign Affairs, Volume 46, January, 1968, pp. 331-334.

power, as in most cases wining wars comes as a result of winning battles. Although such an approach only narrowly grasps the meaning of military effectiveness as it does not address the relationship between political ends and military means, it conveniently provides for the fact that normally battle is the real test of military effectiveness. This limited understanding does not exclude that military brilliance often cannot compensate for political incompetence. The biggest benefit of analysing fighting power is that we become able to explain the danger that comes from confusing flexibility in war with the illusion of being flexible. This way we can build upon insights gained earlier in the chapter detailing the importance of learning and adaptation.[671] This narrow interpretation does not exclude either, that low military effectiveness and disastrous battlefield performance often come as a result of various societal and cultural factors. They root in the absence of respect, trust and openness, and the lack of an implicit brotherhood among soldiers at all levels. Competence at winning battles on the operational level is an important contributor to victory in which aspects such as individual soldiering, battlefield behaviour, and organisational efficacy play an important role.[672] These factors together with societal and cultural determinants emphasise first and foremost the human aspect of war, which requires solid and strong bonds in combat units rather than the availability of advanced technology. In terms of fighting power, the latter "only emerges as a powerful predictor of success when considered in a far more complex and interactive model of training, technology, and terrain."[673] Fighting power indicates that favourable technological disparity might erode over time.

16.2.1 Ancient Greeks, Modern Germans

On their march back home the Greeks kept winning as they consistently outperformed their respective enemies, as did the Germans in World War II in a similar fashion. During the entire war period soldiers of the *Wehrmacht* always outfought the opposing British and American troops. This was true "when they were attacking and when they were defending, when they had a local numerical superiority and when … they were outnumbered, when they had air superiority and when they did not, when they won and when they lost."[674] Explaining such an outstanding fighting power by single attributes appears to be too narrow and dangerous. Even if we take various societal and cultural determinants into account, a German made neither a better soldier than an American, nor is German national character more suitable to wars than the American. The involvement of various difficult-to-conceptualise factors has lead many to state that the issue of military effectiveness is nothing more than an ill-defined concept. War is a complex phenomenon in which the multitude of factors does not make it possible to fully comprehend everything that goes on. Organic Strategic Ecosystem indicates that any interaction with the enemy directly results in causality brake-down and we face different levels of intensity and a confusing interdependency. Consequently, the attempt to discuss military effectiveness even in

---

671 Record, Jeffrey: *Sizing Up Military Effectiveness*, Parameters, December 1988, pp. 25-29.

672 Atkine, Norville de: *Why Arabs Lose Wars*, MERIA Journal, Volume 4, Number 1, March 2000, Internet, accessed 12. 05. 2006, available at www.meria.biu.ac.il/journal/2000/issue1/jv4n1a2.html; Biddle, Stephen/Long, Stephen: *Democracy and Military Effectiveness, A Deeper Look*, Journal of Conflict Resolution, Volume 48, Number 4, August 2004, p. 527.

673 Reiter, Dan/Stam, Allan C. III.: *Democracy and Battlefield Effectiveness*, Journal of Conflict Resolution, Volume 42, Number 3, June 1998, pp. 260-263, 271-275 (quotation p. 274).

674 Dupuy, T. N.: *A Genius for War*, Macdonald and Jane's, 1977, pp. 253-289 (quotation pp. 253-254).

rough terms requires that we look across horizontal and vertical dimensions of activities.[675] The simplest way to define fighting power is seeing it as a process in which armed forces put resources into combat. Probably the biggest similarity that connects the ancient Greeks and modern Germans is that they both regarded themselves as members of a highly integrated and well-lead team perceived by and large as just and equitable. This implicit brotherhood meant that the best men fought shoulder-to-shoulder in the front. Military units were designed to produce fighting men of high quality. In both instances fighting power came as a result of mutual trust, delegated responsibility and independent decision-making. Both the Greeks and the Germans did not attempt to prescribe detailed solutions in advance. Much was left to the intuition of commanders and subordinates on the ground. This led to empowerment throughout the ranks, and the emphasis on the means resulted in their unprecedented military effectiveness. They displayed fearsome cold-bloodedness that ranged from utmost stubbornness in close combat, to large-scale butchering of non-combatants. Similar to the ancient Greeks their modern German equivalents were true professionals both in positive and negative sense. Their battlefield performance during World War II was second to none regardless whether they were in the offensive or the defensive or committed atrocities.[676] However, even such a narrow conceptualisation of military effectiveness aimed at the operational level of war demands a warning:

- Fighting power depends largely on the humans involved and reflects the ability to prosecute operations and employ weaponry. Thus it is a reflection of the quality of an army's personnel and includes aspects that range from battlefield performance to the accomplishment of tasks on various levels and the way those tasks interrelate.
- Fighting power only expresses how successfully a military force operates on the battlefield once it has engaged with the enemy. Numerous examples in history have shown that outstanding effectiveness in battle can often be irrelevant for the outcome of war with the opposite being equally true.[677]

16.2.2 Effectiveness and Technology

Fighting power is the expression of superior human qualities rather than outstanding military technology. A good historical example for disappearing technological superiority, both in terms of quantity and quality can be found in the first phase of British imperialism. Around the end of the 18th century some thousand British soldiers were able to defeat much larger Indian armies, despite the fact that in war-relevant technologies India was superior to Europe. Indian steel was not only better than British, but the steel making techniques in India were far more advanced. Indian forces also had better artillery and musket barrels on their side. However, technological

---

[675] Millet, Allan R./Murray, Williamson/Watman, Kenneth H.: *The Effectiveness of Military Organizations*, in Millet, Allan R./Murray, Williamson: *Military Effectiveness, Volume I: The First World War*, Allen & Unwin, 1988, pp. 1-2; Parker, Christopher S.: *New Weapons for Old Problems, Conventional Proliferation and Military Effectiveness in Developing States*, International Security, Volume 23, Number 4, Spring 1999, p. 131; Creveld, Martin van: *Fighting Power, German and U.S. Army Performance, 1939-1945*, Greenwood Press, 1982, pp. 13-16; Nielsen, Suzanne C.: *Civil-Military Relations Theory and Military Effectiveness*, Public Administration and Management, Volume 10, Number 2, 2005, pp. 61-84.

[676] Millet/Murray/Watman in Millet/Murray, p. 2; Creveld (1982), pp. 163-166; Kanter, p. 79.

[677] Millet/Murray/Watman in Millet/Murray, pp. 26-27; Pollack, Kenneth M.: *Arabs at War: Military Effectiveness, 1948-1991*, CFR Book, 2002, pp. 3-4.

inferiority did not hinder the British to expand their empire and extend their influence.[678] Advanced technology, which can be regarded as an important common element of effects-based operations makes it possible to destroy virtually any target. However, the combined effects of stealth technology and precision weaponry appear to be less convincing in re-establishing security or winning hearts and minds. Despite their superiority according to traditional measures, Iraq reminds us that the ability to end wars does not come as a result of technological solutions. We witness an emerging gap between advanced military technology and the gains we can expect from its application in terms of influencing behaviour and psychological effects. It appears that asymmetric wars require forces committed for the long term on the ground that are as much capable in searching and destroying such irregulars as terrorist cells, as winning hearts and minds of the local population. Enhanced destructive capabilities can improve fighting power, but have clear limitations in terms of stability, order and security. War as a complex adaptive system is composed of situations that can quickly switch from destruction to influence and vice versa. The effects landscape indicates war to be an admixture of many unforeseeable physical and psychological effects, which makes the outcome especially in terms of perception and behaviour unpredictable.[679]

16.3 Feedback and Measuring

In simple English measuring indicates a process that points towards a comparison in which we ascertain a certain quantity in terms of a given standard. The evaluation of the effectiveness of Operations Desert Fox found that despite the obvious success of the bombing campaign, the destruction of various sites never fully equalled with the destruction of assumed centres of gravity. The damages claimed always reflect a combination of a thorough assessment and empty propaganda. Assessing military effectiveness in a way that addresses the psychological domain requires that we focus on perception and influence rather than on military exchange rates based on technological prowess. However, we demonstrated earlier that this area is extremely context dependent, which indicates that any approach to assessing military effectiveness will always be full of controversies. The frictional, chaotic, and complex reality of war indicates the existence of so many contextual factors that the relationship between the action taken, the object selected, and the consequence in the form of desired effects will always be hidden to a certain degree.[680]

---

[678] Rosen, Stephen Peter: *Military Effectiveness, Why Society Matters*, International Security, Volume 19, Number 4, Spring 1995, pp. 22-23.

[679] Valentin, Marcel (Gen.): *Military Effectiveness in the Face of Terrorism*, Le Figaro, Monday 23 January 2006, translated by Leslie Thatcher, Internet, accessed 21. 03. 2006, available at www.truthout.org/cgi-bin/artman/exec/view.cgi/48/17158.

[680] Gove, p. 1400; Cordesman, Anthony H.: *The Military Effectiveness Of Desert Fox: A Warning About the Limits of the Revolution in Military Affairs and Joint Vision 2010,* Center for Strategic and International Studies, 26 December 1998, pp. 29-31; For an excellent review regarding the effectiveness of the 1991 Gulf War see Keaney, Thomas A.: *Surveying Gulf War Airpower*, Joint Force Quarterly, Autumn 1993, pp. 25-36.

16.3.1 Feedback and Control

Western thinking is inherently linear and efficiency obsessed. This is manifest in its general preoccupation with numbers, which are often regarded as the only reality instead as means to look at reality. This preference is not surprising since numbers allow for management, something that is seen in Western culture as very important: control. Numbers and metrics are regarded as hard facts and number crunching as the primary means of control. Unfortunately, controlling a complex adaptive system such as war is very difficult if not impossible. Fighting power and most of its attributes depend on humans and express performance capabilities, which can never be reproduced by simple measurement. Military effectiveness emerges as a result of qualities and behaviours that are choices made by people on all levels. The Organic Strategic Ecosystem indicates that military effectiveness comes as much as the result of satisfying the superiors' needs as that of local knowledge and expertise. Any complex adaptive system lives on feedback; therefore probably the biggest difference between feedback and measurement is that the former is self-generated and depends on context. Feedback in a complex adaptive system changes constantly over time as boundaries are never static, but permeable. It is not only essential in terms of adaptation and learning, but also an important contributor to fitness. Feedback indicates that instead of letting measures define what is meaningful, the emerging meaning of our actions should define the measures.[681] In other words, feedback is the essence of a complex adaptive system and in the case of war it is present in the interaction of the belligerents. It indicates that effects-based operations demand a conceptualisation in which the means applied are as much important as the ends sought. Feedback also means that we can never fully control events. As Clausewitz emphasised war is never "the action of a living force upon a lifeless mass. … Thus [we are] not in control: [the enemy] dictates [us] as much as [we] dictate to him."[682]

16.3.2 Combat and Effectiveness

Military effectiveness grasped on the operational level as fighting power is not only manifest in combat, but also determines its outcome. Thus the question of whether it is possible to quantify it in order to make military effectiveness measurable arises naturally. In his attempt to identify a useful theory of combat, Dupuy referred to Clausewitz and claimed that he had an analytical approach to war and thought of combat in mathematical and quantitative terms. Certainly, it is true that Clausewitz used a vocabulary, which was interwoven with terms and expressions borrowed from various natural scientific disciplines. It is also true that Clausewitz referred to various measures throughout his work such as scale, degree or quantity to which, according to Dupuy, at least tentative values can be given and expressed as the *Law of Numbers*. This law makes it possible for him to determine the outcome of battles, hence to measure fighting power and military effectiveness. Without going too much into detail, for Dupuy fighting power (P) was the product of the number of troops (N), variable circumstances that affect a force in battle (V),

---

[681] Gove, p. 1400; Wheatley, Margaret/Kellner-Rogers, Myron: *What Do We Measure and Why? Questions about the Uses of Measurement*, Journal for Strategic Performance Measurement, June 1999, Internet, accessed 19. 05. 2006, available at http://www.margaretwheatley.com/articles/whymeasure.html; Murray, William S.: *A Will to Measure*, Parameters, Autumn 2001, pp. 134-135; Janssen, Heidi J. W./Toevank, Freek-Jan G./Smeenk, Belinda J. E./Voskuilen, Marion J. M.: *Psychological Operations, Considerations on its Measurement of Effectiveness*, TNO-FEL Concept Paper, 09. 11. 2003.

[682] Quotation in Clausewitz, p. 86.

and the quality of the force involved in battle (Q). Consequently, he claimed that fighting power can be seen as a result of the following equation

$$P = N * V * Q$$

The equation also makes it possible to express relative military effectiveness in the case of two belligerents. It can be expressed as a difference in the belligerents' respective military effectiveness where (r) identifies the red force and (b) the blue force

$$P = \frac{N_r * V_r * Q_r}{N_b * V_b * Q_b}$$

His approach is especially interesting from a complex adaptive system point of view, as Dupuy explicitly emphasised the importance of a bottom-up, inductive process in approaching military effectiveness. He assumed that this way it becomes possible to provide insights into the various interactions of the variables and get to a reasonable quantification. However, even he had to eventually admit that this quantification does not allow predicting the future with any accuracy. The best the equation can provide for is the avoidance of dangerous assumptions and false conclusions. Thus Dupuy could not address the multitude of factors such as leadership, morale, cohesion, motivation, initiative, and trust, which are easily identifiable, but also frustratingly intangible. In order to get a grip on higher order effects in the psychological domain, the best he did was to suggest that the effects of intangibles should be determined by historical analysis.[683] Thus even the attempt to assess military effectiveness in the internal and rather limited context of combat expressed as fighting power, suffers from inaccessibility of reliable data. Assessing effectiveness in a much broader context with its wider perspective pointing towards the political interest of the belligerents is even less reliable and has, at best, a transitory value. Consequently, it should not come as a surprise that measures of military effectiveness such as battle damage assessment are normally related to physical activities since behavioural characteristics indicating higher order follow-on effects are the most difficult to measure.[684]

16.3.3 Military Effectiveness and Wicked Problems

Complex adaptive systems are open ended, which makes the formulation of any outcome in terms of desired effects extremely difficult if not impossible. As a result, the traditional planning approach emphasising reasoning, rationality and analysis must often yield to a more organic *feeling* approach of engagement, action and overcoming. In the framework of the proposed

---

[683] Dupuy, T. N. (Col.): *Understanding War, History and Theory of Combat*, Leo Cooper, 1987, pp. 13, 21-30, 51-61, 105 (Dupuy preferred the term *combat power*); Murray, Williamson: *Thoughts on Effects-Based Operations, Strategy, and the Conduct of War*, Institute for Defense Analysis, January 2004, pp. 5-17; Burkett, Wendy H.: *Assessing the Results of Effects-Based Operations (WBO): The Relationship between Effects-Based Operations and the Psychological Dimension of Warfare*, U.S. Army War College, 07 April 2003, pp. 10-17.

[684] DuBuis, Edmond/Hughes, Wayne P. Jr./Low, Lawrence J.: *A Concise Theory of Combat*, Institute for Joint Warfare Analysis, Naval Postgraduate School, October 1998, Internet, accessed 19. 05. 2005, available at www.militaryconflict.org/Concise%20Theory.htm; Low, Lawrence J.: *Anatomy of a Combat Model*, Review Copy, pp. 18-23, Internet, accessed 19. 05. 2006, available at www.militaryconflict.org/Anatomy%20of%20a%20Combat%20Model_1.

effects landscape we conceptualised war as a large and interconnected network of various objects. Due to epistatic interactions among them, we always have to juggle with conflicting constraints. We addressed the dual nature of effects along two dimensions such as interactions and couplings. Whereas interactions can be linear or complex, couplings can be tight or loose. The four possibilities revealed that as outputs from parts of the network become inputs to others, it becomes extremely difficult to define cause-and-effect relationships in a meaningful way. Consequently, efforts to plan for effects and find methods of intervention in the form of courses of action can become troublesome activities. In terms of the Organic Strategic Ecosystem, we always have to expect waves of repercussion since influencing any given nod can induce severe and unexpected effects elsewhere. Thus it appears that the three common elements of effects-based operations reflect northing more than our arrogant confidence in detecting root causes.[685] Most challenges posed by war cannot be solved through scientific analysis. War happens on a continuum in which we always face ill-defined and inseparable problems. The lack of clarifying traits in such *wicked* problems allows for resolution rather than solution – over and over again. The following listing provides for a better understanding of the nature of such problems:

- *Formulation* – wicked problems cannot be formulated definitively and exhaustively since formulating a wicked problem is a problem in itself. Setting up and constraining the solution space, constructing meaningful measures of performance are at the heart of the problem's wickedness. Wicked problems are infinite. There are no criteria that tell when solutions are found. Terminating works are rather due to external reasons such as running out of resources rather than to internal reasons coming from the *logic* of the problem.
- *Objectivity* – wicked problems do not allow for objectively decisive criteria to define the correctness or falseness of solutions. Thus solutions can never be true or false only bad or good as they are influenced by the interplay of various cultural, social and political factors. Wicked problems have no solutions that can be tested immediately or ultimately. Whatever the solution to a problem we can be sure that it always generates unintended and undesired consequences, which often outperform the desired effects we want to achieve.
- *History* – wicked problems mean that history matters. Every solution implemented has a consequence that leaves traces we cannot reverse. Attempts to undo or reset past actions poses a significant challenge as they also represent further sets of wicked problems. Wicked problems do not have an enumerable set of potential solutions. Sometimes no solution can be found, or the selected solution is just as good as any other potential solution. What should be pursued, implemented and enlarged is a matter of subjective judgement.
- *Uniqueness* – wicked problems are essentially unique. They always yield a distinguishing property of importance since there are no classes that allow for principles of solutions fitting to all members of a class. Despite obvious similarities there is no certainty about the particulars of any given problem. Wicked problems are always a symptom of other problems. Addressing the problem at any given level can never be decided logically since there is no natural level of wicked problems. Even systemic approaches and incrementalism can make things worse, rather than better.
- *Explanation* – wicked problems can be explained in numerous ways since there is no rule that determines which explanation is correct. Thus the choice of explanation is arbitrary and

---

[685] Rittel, Horst W./Webber, Melvin M.: *Dilemmas in a General Theory of Planning, Policy Sciences,* 4/1973, pp. 157-158, 160-167.

guided by attitudinal criteria since people generally choose those explanations that are most plausible to them. Wicked problems stand for ambiguity of causal webs in which solutions always point towards further sets of dilemmas. Actions always generate consequences and the effects regardless whether desired, undesired, intended, unintended, good or bad matter a great deal to those who are affected.[686]

16.3.4 Theoretical Biology, Fittness Landscape, and Iraq

The American led Coalition Forces entered Iraq in March 2003 forcing an end to Saddam Hussein and his regime. After the war conditions for the Iraqi people were different from the speculations before the conflict. Although no acute humanitarian crisis erupted, the coalition forces encountered a situation characterized by decreasing civil insecurity and looting.[687] This facilitated an insurgency that grew in size and complexity over the course of 2004. At the beginning of 2004 attacks numbered approximately 25 per day and then averaged around 60 by the end of the year. Insurgents were able to increase activity around key events, for example, the number of attacks reached approximately 300 on the day of election. Although Coalition Forces continued to be the primary targets, Iraqi officials, foreign nationals and the country's infrastructure were not spared. The continuing attacks have undermined efforts to reconstruct and stabilize the country and caused the death of more than 3,000 Coalition soldiers and wounded 22,000 more. Whereas in November 2003 the number of insurgents was estimated to be around 5,000, a year later their number doubled, and roughly 50 militant cells could be differentiated enjoying increasing popular support. The number exploded a year later as the Iraqi intelligence service director spoke of 40,000 full-time and 200,000 part-time fighters with no sign that things would get better.[688] The country can be characterised by continuing violence, non-existing or shattered state institutions, a non-functioning economy, and a war-torn and exhausted society. So far the Coalition has failed to reconstruct Iraq in political, economic, social and security terms. Although these four areas interact in a complex and intimate way, requiring a constant dialogue on a very broad basis, the occupants have increasingly withdrawn into a physical and psychological bunker. Many signs indicate that the general "obsession with control was an overarching flaw in the U.S. occupation from start to finish."[689] We indicated earlier that control has relevance only to a small portion of the continuum of war, as the rest has much more to do with coping. Although most objectives of Operation Iraqi Freedom were not purely military, they were relatively clearly stated. Thus objectives included the ending of Saddam Hussein's regime; the identification, isolation and elimination of weapons of mass destruction; the searching, capturing and driving out terrorists from the country; the collection of intelligence related to terrorist networks; the collection of intelligence related to the global network of illicit weapons of mass destruction; the ending of sanctions and delivering humanitarian support to the

---

[686] Ibid., pp. 160-167.

[687] *Iraq Reconstruction – Introduction,* Internet, accessed 26. 01. 2007, available at www.globalsecurity.org/military/ops/iraq_recon_intro.htm.

[688] *Iraqi Insurgency Groups,* Internet, accessed 26. 01. 2007, available at www.globalsecurity.org/military/ops/iraq_insurgency.htm; *U.S. Casualties in Iraq,* Internet, accessed 26. 01. 2007, available at www.globalsecurity.org/military/ops/iraq_casualties.htm; Hoffmann, Bruce: *Insurgency and Counterinsurgency in Iraq,* RAND National Security Research Division, June 2004, pp. 11-14.

[689] Diamond, Larry: *What Went Wrong in Iraq,* Foreign Affairs, Internet, accessed 25. 01. 2007, available at www.foreignaffairs.org/20040901faessay83505/larry-diamond/what-went-wrong-in-iraq.htm.

displaced and needy citizens; the securing of Iraq's oil fields and resources; and the creation of conditions that make the transition to a representative self-government possible.[690] In terms of biology the original evolutionary stable situation between the United States and Iraq changed dramatically as a result of 9/11. However, because the war was waged in a symmetric, force-on-force, firepower-centric manner, Iraqi resistance was smashed within weeks, and achieving the highly ambitious objectives through the co-ordinated sets of various sorts of effects appeared possible. The maximising approach of strategy development aimed at achieving centralised effects seemed to be promising and realisable. Unfortunately, soon after the traditional war was officially ended and victory of the Coalition Forces declared, the situation started to deteriorate until it slid out of control. Although it became increasingly clear that realising the original objectives was more and more impossible, there were no attempts to lessen control and lower the initial ambition in order to adapt to changing conditions. In other words, instead of establishing a mechanism that can increase the chance to discover new and exploitable opportunities, the American led Coalition Forces shut down the possibility to discover and expand on good-enough scenarios. Their rigid focus aimed at climbing hills on the landscape identified for a given scenario before the war resulted in an alarming inefficiency. An abundance of factors such as a serious legitimacy problem with the international community, the lack of area and linguistic experts, the Iraqi's distrust and deep suspicion regarding the occupation's real motives, their partial and puzzled understanding of democratic governance, and Western cultural bias seeing democracy as a one-fits-all, prohibited successful jumps across the landscape and the discovery of new and promising hills.[691] It appears that the situation in Iraq is similar to the situation we described earlier as the Red Queen in which the Coalition Forces must run faster and faster in order to stay at the same place. Their average fitness level is constantly declining and the chance for extinction, which equals defeat increases steadily. The Coalition is bogged down so much and the number of conflicting constraints it has to manage, is so high that whatever they do and wherever they look only vicious circles are available. In the fourth year of the invasion there was not even a *not-very-bad* scenario in sight.[692] Despite the abundance of publications dealing with the advantages of network-centric warfare, effects-based operations and similar concepts we have the impression that the West still does not possess the flexibility and agility to respond to quickly altering challenges in an appropriate way. Its obsession with efficiency, analytical rationality, technological focus does not make it possible to develop the level of adaptability that is needed to evolve with a very complex situation such as Iraq. The structures, models, Western armed forces employ are not fit enough to compete for survival with a challenger that has less bureaucracy, but more ad hocracy. Both the situation in Iraq and the lessons learned from evolutionary biology indicate that Western armed forces are extremely specialised and occupy only a narrow field on the fitness landscape. Consequently, they do not possess the ability to move constantly in order to find higher general regions. Based on their causality sensitivity they are unwilling to employ trial-and-error mechanisms, which are so important both for learning and adaptation. We demonstrated earlier that the more the situation

---

690 *Operation Iraqi Freedom,* Internet, accessed 26. 01. 2007, available at www.globalsecurity.org/military/ops/iraqi_freedom.htm.

691 Diamond, ibid.

692 Baker, James A. III./Hamilton, Lee H. et. al.: *The Iraq Study Group Report,* United States Institute of Peace, 6 December 2006, pp. 9-27.

becomes chaotic, the more we have to rely on decentralised effects that come as a result of bottom-up initiatives. When we see Western militaries as species they do not have the means to become truly networked in which they successfully subdivide into many local races that can search and shuffle continually about the landscape. Although this way at least one local race can find a higher peak and pull the entire species towards a better position, the fear that the average fitness of the species as an immediate effect can decrease is all too great. Iraq has been so far a good example that a complex problem ranging into many and confusing areas cannot be solved in a way that attempts to simplify. As theoretical biology and the fitness landscape metaphor indicate in theory, and the situation in Iraq in practice, in the case of too many conflicting constraints no good solutions can be found. In other words, in Iraq we have to deal with chaos in which every solution is just as good as any other solution.

16.4 Conclusion Part III

The 20th century was full of examples that as soon as a war started it tended to generate its own politics based on its own momentum. This attribute rendered both the original political purposes obsolete and erected new political imperatives. Consequently, any conceptualisation of war can be scarcely more than an attempt to grasp a continual and kaleidoscopically shifting process. War perceived in traditional, rigid and mechanistic terms resembling similarity with engineering means that we emphasise the importance of a predefined end-state, top-down command and control, and a slavish adherence to various measures. In the age of increased complexity such an approach imposes demands upon Western armed forces they might not be able to meet. In contrast, war conceptualised as an interactive process means that it must be defined as much by political goals pursued by the military, as by acknowledging the limitations of militarily realisable political goals.[693] An organic conceptualisation takes into account that one at the expense of the other can easily jeopardise success. Rigidity and blind adherence to predefined objectives can result in mounting costs of money and men. An exclusive focus on the strategic level narrows exploitable tactical options with the consequence that we become imprisoned in false hopes chasing desired effects. War conceptualised in the framework of the Organic Strategic Ecosystem indicates that Western political-military thinking is based on dangerous assumptions:

- Due to its inherent bias towards the instrumental dimension of war it cannot see and address international security problems other than in quantitative and technological terms. Traditional attributes of war such as uncertainty, risk and ambiguity increasingly disappear from the vocabulary or are buried under empty concepts.
- This ignorance and the resulting mechanistic approach to war explains why a force employment concept such as effects-based operations offering “quantitatively guaranteed predictive capabilities with respect to human affairs“ could become an all encompassing credo.[694]

---

[693] Weigley, Russell F.: *The Political and Strategic Dimensions of Military Effectiveness*, in: Millet, Allan R./Murray, Williamson: *Military Effectiveness, Volume III: The First World War*, Allen & Unwin, 1988, pp. 341-344.

[694] Murray, Williamson: *Clausewitz Out, Computer In, Military Culture and Technological Hubris*, The National Interest, Summer 1997, Internet, accessed 15. 05. 2006, available at www.clausewitz.com/CWZHOME/Clause&Computers.html.

Effects-based operations represent a dangerous simplification of war and the only logical outcome of such an approach can be nothing else than panaceas that promise quick, easy and cheap victories. Organic Strategic Ecosystem indicates war to be an open-ended dynamic process in which the best we can do is to act on local information, learn from mistakes and hope that a better mix of training, leadership, equipment and weaponry can result in victory. Better military discipline contributes to better strategies, better command and control and higher military effectiveness.

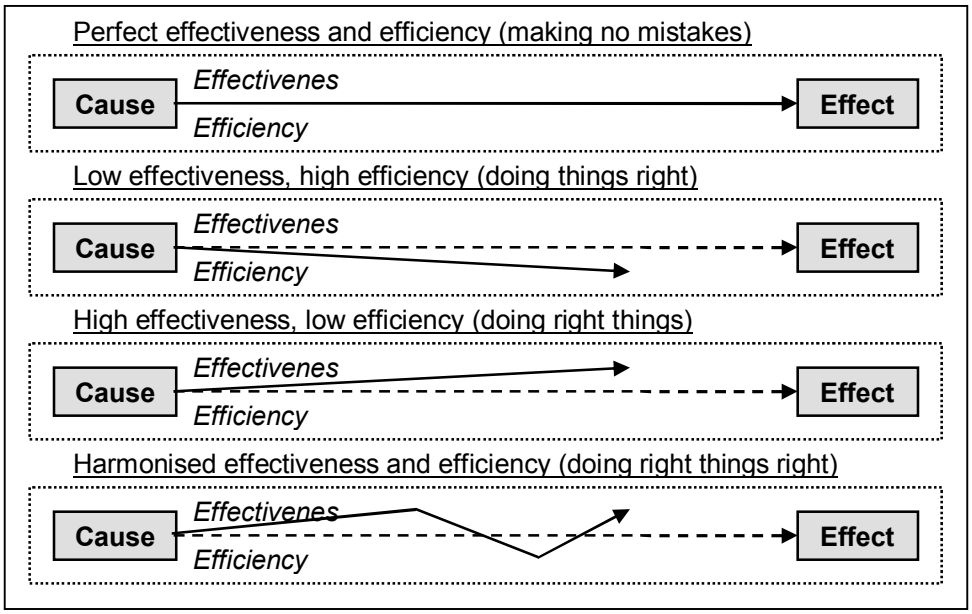

Figure 23: Causality, effectiveness and efficiency

Earlier we indicated that both effectiveness and efficiency refer to the relationship between cause and effect, although they indicate different mechanisms as depicted in Figure 23. Probably the biggest benefit that comes from the power of learning and adaptation is the ability to harmonise effectiveness with efficiency. Although even the combination of both does not allow for perfect solutions, it can guarantee that we do not fall out of alignment in terms of external demand and internal variation. Being effective and efficient means doing the right things right, and successfully combining the science and the art of war. Unfortunately, it appears that the West tries to handle 21st century challenges with a 20th century approach. It still regards important aspects of war such as strategy development, command and control and military effectiveness as part of a larger symmetrical engagement. Asymmetric and low-tech enemies since 1990 have shown that will, tenacity, skill and endurance can successfully oppose superior Western firepower. It is not destruction in traditional terms, but time and commitment that will be important factors of victory in the Third Wave. Consequently, enemies of the future will not see victory or defeat in terms of decisiveness coming from a swift and crushing military success. They see war as a prolonged stalemate, which drags on with the purpose to erode political support in the West that can eventually turns technological weakness into an exploitable

advantage.[695] Organic Strategic Ecosystem indicates a continuous interaction of the belligerents in which both sides are simultaneously attacking and defending. Their efforts are continuous and disturbed only by few interruptions. The forces involved are dispersed in order to exploit open areas containing good-enough opportunities. Similar to biological evolution, the aim is not so much to seek a direct head-on annihilation of the enemy, but to confuse him through constant learning and adaptation manifest in quick and fluid movements rather than precise measurements. An organic conceptualisation of war means that we put emphasis on improvisation based on bottom-up local knowledge and working without any direct assistance from the top. Planning is seen as important, but not too important since success comes mostly as a result of loosely organised, fairly autonomous and dispersed units that carry out individual actions. The proposed Organic Strategic Ecosystem offers an enhanced conceptualisation of effects-based operations. However, if we want to see war as an interactive process that requires continual effort and commitment over a long period of time, we have to rethink in terms of strategy development, command and control, and military effectiveness.

[695] Murray, Williamson: *Military Culture Does Matter*, Strategic Review, Spring 1999, pp. 32-40; Scales, Robert H. Jr.: *Adaptive Enemies, Achieving Victory by Avoiding Defeat*, Joint Force Quarterly, Autumn/Winter 1999-2000, pp. 7-14.

17 Conclusion

In the thesis we analysed a recent and very fashionable concept called effects-based operations, which drives both the employment and transformation of Western armed forces. In order to better understand effects-based operations we suggested using *On War*, Clausewitz's epic work as background. We made it clear that in terms of effects-based operations war is seen as a management activity with a clear cut beginning and a definite end.

1) In the thesis we found that the concept is synonymous with the exploitation of technological advantage and the efficient use of scarce resources, in which capital can mostly substitute for personnel. It rests on scientific assumptions based on analysis and prediction with which it is believed that destroying or influencing assumed centres of gravity or critical nods and elements can yield cheap victories. We also found that there is a clear and distinguishable relationship between 20th century strategic theories and effects-based operations. More specifically, according to the three common elements of the concept such as the emphasis on causality, technological focus and systems thinking, the concept belongs to the class of air force theories. At the beginning of the last century the assumed technological superiority of air power to achieve strategic effects on their own, motivated military thinkers to search for mechanisms that allow victory without the involvement of irrational costs and losses. In the end and at least in theory, air power offered a promising solution to protracted surface-oriented attrition and annihilation warfare. Unfortunately, these basic assumptions have never been really validated in the wars of the 20th century. It appears that most theorists have felt, rather than known, what air power can achieve. Air-force theories were originally fed by the false hope that war can be taken away from the battlefield. However, the airplane established only an additional area in the third dimension fought with equal ferocity. Although air power's maturity and independence was regarded for many years as the driving force in strategic thinking, in the end it was on the battlefield where air power ascended to equality with the other services. Consequently, any sober theory of warfare must take into account that waging war is an act that has always been more than linking ends with means in a simple deductive fashion, and detecting obvious causality at the strategic level in the form of desired or decisive effects.

2) In the thesis we demonstrated that effects-based operations represent deductive reductionism and causal laws attempting to predict certain desired effects. The supporting assumption is that war displays order and equilibrium, the possibility for rational choice, and the ability to steer and control events. In contrast, war outlined by Clausewitz stands for variety and novelty in which despite our best effort to comprehend, certain properties remain unknowable to the human mind. He emphasised that war is fought on a spatial and temporal continuum involving both the material and non-material domains. War is as much a physical as a psychological phenomenon, which spans over many layers. Although war can be described in general terms using causal relationships, effects that go beyond the immediate spatial and temporal levels cannot be predicted with any accuracy. Understanding war this way indicates that it is possible to only predict some things, especially those that are local to us both in space and time. Clausewitz suggested that everything in war is interrelated and all we can attain is nothing more than a temporary and partial interpretation. In other words, we often confuse causation with correlation

and simulation with prediction. Whereas the former refers to our preference for creating retrospective validation to identify best practices, the latter points to the fact that even if we can simulate something it does not obviously mean that we can equally predict its future. War displays unpredictability in two ways: in terms of what we are trying to achieve (effect), and how it becomes possible to achieve what we want to achieve (cause). Thus war stands for a general unpredictability in terms of ends and means. Several different futures are possible and there is not always time for mechanical, deductive systemic analyses aimed at detecting causality. Probably the most important consequence of such an approach is that instead of focusing on certain desired effects, we should rely on the ability to respond consistently to the unpredictable nature of war. According to Clausewitz war cannot be waged based on single and prescriptive models. It requires that we evolve rapidly in order to handle dynamic and changing situations.

3) In the thesis we found that in war we must be satisfied with understanding certain general features in terms of correlation, rather than attempting to discover a mechanism that links causes with effects directly. In contrast, effects-based operations as a theory aim at exploiting causal relationships. Recent military operations in Afghanistan and Iraq have shown that the relationship between ends and means might be clear at the strategic level, but it becomes considerably less clear as specificities emerge, and more ambiguous as the full range of military options expands. Consequently, most assumptions of effects-based operations have no sound foundation and can be applied only with limitations. The global War on Terror aimed at fighting shadowy enemy organisations is the best example of an increasing difficulty to link military means with political ends, and tactical actions with strategic objectives directly in order to identify, penetrate to and destroy the very centres within enemy organisation. Coalition forces in Iraq and Afghanistan have experienced the difficulty to circumvent the slow and painful processes of attrition and annihilation with the aim to achieve quick and decisive victory in the psychological domain to influence enemy thinking and behaviour. The various commitments of the West since the 1990's have shown how difficult it is to save precious resources in terms of time, money and manpower by collapsing enemies' systems that exist outside the traditional boundaries of a nation-state, from the inside-out. Information superiority and technological sophistication are at the very heart of effects-based operations. However, they can best be seen as enabler, but not as ultimate leverage; therefore the assumed advantages of effects-based operations can often mean no advantage at all. War is full with emerging opportunities that can only help explain qualitative behaviour, but never accurately predict futures in terms of desired effects.

4) In the thesis we also demonstrated that effects-based operations as a concept is based on deduction, analytical rationality and systemic thinking, which have clear limitations for war. The focus on ends/means rationality does not encompass the Clausewitzian image of war, emphasising a frictional, chaotic and complex reality sufficiently into account. We demonstrated that although war might display direct causality, assumptions that rest on equilibrium and a constant environment make up only a small fraction of war's bewildering nature. Consequently, any uncritical attempt aimed at detecting direct causality expressed in the form of desired effects is scarcely more than a fallacy. We can say that at a first glance the concept of effects-based operations appears to be weighty both in scope and insight as it draws on a diverse array of scientific ideas in order to generate hypotheses about success in war. Although this eclecticism

is admirable, it often indicates inconsistency and a vocabulary that has no sound foundation. Despite claims that much of war can be addressed by deductive thinking, it is very difficult to deliver arguments for why certain factors should be regarded as more important than others. We demonstrated that even deductive thinking and analytical rationality do not make possible to distinguish sufficiently among various alternatives and cannot satisfyingly explain the preference for certain selected factors. The result is that many effects-based operations publications read like an accumulation of disparate and scattered statements lacking a true theoretical basis in which the central argument is nothing more than simple and uncritical descriptions of positive findings.

5) In the thesis we proved that rigidity and blind adherence to predefined objectives can result in mounting costs both in terms of money and men. An exclusive focus on the strategic level only narrows exploitable tactical options. Consequently we easily become imprisoned in false hopes chasing desired effects. The concept of effects-based operations is the best example that the Western world cannot see and address international security problems other than in quantitative and technological terms. Traditional attributes of war such as uncertainty, risk and ambiguity increasingly disappear from the vocabulary or are buried under empty concepts. This ignorance and the resulting mechanistic approach to war explain why a force employment concept such as effects-based operations could become an important point of focus. We found that effects-based operations represent a dangerous simplification of war and the only logical outcome can be nothing else than a panacea that promises quick, easy and cheap victories. In contrast, in the thesis we expanded on an organic image of war and emphasised the importance of learning and adaptation, which make it possible to find a harmony between effectiveness and efficiency. Although this approach does not allow for perfect solutions, it can guarantee that we do not fall out of alignment in terms of external demand and internal variation. Being effective and efficient at the same time means doing the right things right. We can successfully combine the science and the art of war. In other words, we have to pay as much attention to the end sought as to the means applied. Thus the three parts of the thesis stand for three sets of reasons for being sceptical regarding the practical utility of effects-based operations and offers critical arguments against such a conceptualisation of war.

6) In the thesis we addressed the fact that many proponents of effects-based operations related the concept to complexity theory and suggested to see the enemy as a complex adaptive system. War perceived this way opens the door for finding analogies with biological evolution, which again challenges the assumptions upon which effects-based operations are built. An organic image of war requires strategy development, which is different from the top-down, mechanistic and analytically rational, and prescriptive model upon which the concept is built. After our study of complexity theory we found that success in war equates to a phase transition in which we do not settle into a stable equilibrium or fall entirely apart. Thus victory in war requires a mix of strategies that are rigid enough to organise change, but not too rigid to prevent change. War as a complex adaptive system indicates that often the central challenge in strategy development is to manage change. Instead of focusing on certain desired effects we must always be prepared to accept rapid and unpredictable changes that require various semi-coherent strategic directions without a clear focus in terms of strategic effects. In a similar fashion Clausewitz suggested that accepting surprise, making moves, observing the results and

continuing with the ones that seem to work are inherent features of war. Consequently, any conceptualisation of war can be scarcely more than an attempt to grasp a continuously shifting process. Effects-based operations display war in a rigid and mechanistic Jominian way that resembles similarity with engineering. The concept emphasises the importance of a predefined end-state, top-down command and control, and a slavish adherence to various measures. As military operations since the 1990's have shown, in the age of increased complexity such an approach imposes demands upon Western armed forces they might not be able to meet. By contrast war conceptualised as an interactive, open-ended process means that it must be defined as much by political goals (effects) pursued by the military as by acknowledging the limitations of militarily realisable political goals (means).

7) In the thesis we proved that simplified and superficial discourses can provide only for thin explanations that possess limited power. It does not come as a surprise that most approaches to effects-based operations point towards themselves rather than to any particular direction. Although they might address important attributes, those attributes are nothing more than a fraction in the multitude of factors characterising war. As Clausewitz emphasised, war happens on a continuum and it is understandable that focusing only on certain factors is necessary for analytical reasons. The logical consequence is a very narrow conceptualisation that does not provide for developed and compelling explanations, but exhibits two interrelated methodological problems. Whereas the first problem is that effects-based operations address war mostly on the strategic level, the second is that the concept regards wars and operations as standard phenomena. Although war is context-dependent, similar to the strategic bombing genre of military thinking, the basic assumptions rest on a uniform class that have similar if not identical attributes. Thus by focusing on commonalities war's important variations are treated as secondary. Instead of examining variations in terms of their appearance, the emphasis is on apparent similarities. This appears to be plausible at first glance, but a closer examination reveals it to be problematic. It obscures truly intriguing differences that might theoretically belie the notion that wars and military operations should be analysed as a uniform class. Consequently, if the West wants to maintain its position in the future it must develop an appropriate conceptualisation of war and take the consequences in terms of strategy development, command and control and military effectiveness fully into account. It must look as much on past errors as present successes in order to avoid sweeping generalisations without taking into account internal structures. Approaching war in terms of ends/means rationality can easily result in a technology oriented conceptualisation such as effects-based operations.

8) In the thesis we demonstrated that an exclusive focus on the end, together with the emphasis on advanced technology and systemic approach can give the impression that war is a commodity that can be wrapped into catch phrases. Although effects-based operations do not rest on complete or original arguments, the concept is often sold as a novel and revolutionary employment of force. In his work, Clausewitz wanted to "iron out a good many kinks in the minds of strategists and statesmen [and] to show what the whole thing is about and what the real problems are that have to be taken into account in actual warfare."[696] In a similar, but more limited fashion it was our intention to examine the utility of a recent and fashionable force

[696] Quotation in Clausewitz, p. 78.

employment concept, and to check its relevance in practical terms. In the end we delivered a conceptualisation that attempts to find the oft missing link between the theory and practice of war. Consequently, the thesis can be seen as a deliberate effort to merge insights from different, but related fields of scientific thinking. War seen as a complex adaptive system negates the possibility to establish a sort of military checklist offering the take-this-get-that simplicity of effects-based operations. We displayed war as a phenomenon that allows for causal explanations only with clear limitations. The biological analogy shows war to be a co-evolutionary process that spans over many levels involving an abundance of factors. In other words, we must always deal with circular causality, feedback and conflicting constraints, all working against an effort involving deduction and analysis. The obvious similarity between war and biological evolution has another important consequence: any theory can aim at explaining real world phenomena, but in the case of war and its interactive character, a theory has only utility if it helps determine to what extent past experience can be useful for current problems at hand. Although it is always helpful to discern certain universals that can guide our actions, turning those universals into fixed laws and values with the hope to detect causal relationships is mostly impossible.

9) In the thesis we treated war as a context-dependent human phenomenon that does not provide for blueprints to act. However, we also demonstrated that war seen as a complex adaptive system provides for a comparative methodology in a dual sense. First it approaches war as a phenomenon that moves back and forth from stability to chaos, and displays it as a process that simultaneously occurs across various levels. The most important message of such an approach is that in war success often demands the ability to learn from actual experience, rather than the ability to formulate action based on past experience. Consequently, waging war is as much a science as an art, which must be taken into account in every conceptualisation. Given this research conclusion and the increasing popularity of effects-based operations, what practical guidance can such a thesis offer? Conceptualising war as a complex adaptive system indicates an inherent difficulty when attempting to turn the insights gained into actual policies, programs and strategies. It does not offer clear and simple answers to the way armed forces should train soldiers, write doctrines and develop leaders in the future. The 21st century and the Third Wave have just begun and as one contemporary scholar emphasised "it is time to let a hundred schools of thought bloom."[697] It is our hope that seeing war as a complex adaptive system and expanding on the analogy between war and biological evolution will be one.

[697] Quotation in Metz, Stephen: *A Wake for Clausewitz: Toward a Philosophy of 21st-Century Warfare*, Parameters, Winter 1994-95, p. 132.

References

OWN CONTRIBUTIONS

[1] **Jobbagy Zoltan (Maj.):** *A hatás alapú hadviselés haditechnikai aspektusai, (Military-Technological Aspects of Effects-Based Operations),* Proceeding, 2003 C+D Conference "Better Technology, Higher Security", Budapest, Hungary, 05. 11. 2003, available in: Haditechnikai Füzetek, 1/2004, pp. 26-28

[2] **Jobbagy, Zoltan (Lt. Col.):** *Developing Strategy: On Effects-Based Operations, Complex Adaptive Systems, and the Importance of Biological Connotations,* Militaire Spectator, June 2007, pp. 251-259

[3] **Jobbagy, Zoltan (Lt. Col.):** *Effects-Based Operations and the (Clausewitzian) Reality of War, A Useful Concept or Silver Bullet?* Presentation, SMi Conference "Battlespace Transformation Realising the Value of NEC and NCW", Brussels, Belgium, 18-19 October 2006

[4] **Jobbagy, Zoltan (Lt. Col.):** *Effects-Based Operations and the Changing Face of War,* Introductory presentation as chairman, Marcus Evans Conference "Effects-Based Operations Europe", Barcelona, Spain, 27-28 November 2007

[5] **Jobbagy, Zoltan (Lt. Col.):** *Effects-Based Operations and the Problem of Causality: Simple and Complex,* Joint Force Quarterly, Issue 46, 2007, pp. 90-95

[6] **Jobbagy, Zoltan (Lt. Col.):** *Effects-Based Operations, Causality, and Complex Adaptive Systems*, Presentation, Marcus Evans Conference "Effects-Based Approach to Operations, EBAO in Action: An International Collaboration", Brussels, Belgium, 29 November-01 December 2006

[7] **Jobbagy, Zoltan (Lt. Col.):** *Scrutinising effects-based operations: On military genius, causality and friction in war,* AARMS, Volume 7, Number 1, 2008, pp. 167-174

[8] **Jobbagy, Zoltan (Lt. Col.):** *Strategy Development in a Dynamic Environment,* Presentation, Marcus Evans Conference "Future Land Forces", Prague, The Czech Republic, 18-19 September 2007

[9] **Jobbagy, Zoltan (Maj.):** *Effects-Based Operations and the Age of Complexity: A Critical Reflection*, Militaire Spectator, May 2006, pp. 235-242

[10] **Jobbagy, Zoltan (Maj.**): *Effects-Based Operations and the Biology of War: A Conceptualisation,* TNO Report, Clingendael Centre for Strategic Studies, CCSS-06-002, April 2006

[11] **Jobbagy, Zoltan (Maj.):** *Effects-Based Operations and the Problem of Thinking Beyond: A Critical Reflection,* TNO Report, Clingendael Centre for Strategic Studies, CCSS-06-001, March 2006

[12] **Jobbagy, Zoltan (Maj.):** *Effects-Based Operations Meet Post Conflict Operations, Theory, Reality and the Nature of War,* Lecture presented at the Instituut Defensie Leergangen, Submodule Ontwikkeling van de Oorlogvoering, Class 2006, 17. February 2006, available at www.ccss.nl/publications/2006/20060200_jobbagy.pdf

[13] **Jobbagy, Zoltan (Maj.):** *Effects-Based Operations, A Complexity-Based Approach Using Metaphors,* Presentation, IQPC Conference "Effects-Based Operations", London, United Kingdom, 30-31 March 2004

[14] **Jobbagy, Zoltan (Maj.):** *From Effects-Based Operations to Effects-Based Force: Lessons from Evolutionary Biology can Guide Strategy Making,* Proceeding, SAS-055 Symposium "Analytical Support to Defence Transformation", Norfolk, USA, 26-28 April 2005, see RTO-MP-SAS-055, available at http://www.rta.nato.int/Abstracts.asp#

[15] **Jobbagy, Zoltan (Maj.):** *From Effects-Based Operations to Effects-Based Force: Obstacles and Opportunities,* Presentation, IQPC Conference "Effects-Based Approaches to Operations", London, United Kingdom, 20-21 April 2006

[16] **Jobbagy, Zoltan (Maj.):** *Literature Survey on Effects-Based Operations. A Ph. D. study on measuring military effects and effectiveness,* TNO-FEL, FEL-03-B140, August 2003

[17] **Jobbagy, Zoltan (Maj.):** *Literature Survey on Uncertainty, Non-linearity, Complexity and Chaos. A Ph. D. study on measuring military effects and effectiveness,* TNO-FEL, FEL-04-B061, June 2004

[18] **Jobbagy, Zoltan (Maj.):** *Origins, Nature and Potential of Effects-Based Operations,* TNO, unpublished manuscript, October 2003

[19] **Jobbagy, Zoltan (Maj.):** *Powered Flight, Strategic Bombing, and Military Coercion: Study on the Origins of Effects-Based Operations,* TNO Report, Clingendael Centre for Strategic Studies, CCSS-05-006, November 2005

[20] **Jobbagy, Zoltan (Maj.):** *Wars, Waves and the West: Putting Effects-Based Operations into Context,* TNO Defence, Security and Safety, TNO-DV1 2004 B077, May 2005

BOOKS

[21] **Alberts, David S. and Czerwinski, Thomas J. (ed.):** *Complexity, Global Politics, and National Security,* National Defence University, June 1997, Internet, accessed 25. 11. 2003, available at www.dodccrp.org/comindex.html

[22] **Alberts, David S. and Gartska, John J. and Hayes, Richard E. and Signori, David A.:** *Understanding Information Age Warfare,* CCRP Publication Series, August 2001

[23] **Alberts, David S. and Gartska, John J. and Stein, Frederick P.:** *Network Centric Warfare, Developing and Leveraging Information Superiority,* 2nd Revised Edition, CCRP Publication Series, July 2002

[24] **Alberts, David S. and Hayes, Richard E.:** *Power to the Edge, Command and Control in the Information Age,* CCRP Publications Series, June 2003

[25] **Ashby, Ross W.:** *An Introduction to Cybernetics,* Chapmann & Hall Ltd., 1957

[26] **Atkinson, Simon R. and Moffat, James:** *The Agile Organization, From Informal Networks to Complex Effects and Agility*, CCRP Publication Series, May 2005

[27] **Axelrod, Robert and Cohen, Michael D.:** *Harnessing Complexity, Organizational Implications of a Scientific Frontier*, The Free Press, 1999

[28] **Back T. and Fogel D. and Michalewicz Z.:** *The Handbook of Evolutionary Computation,* Oxford University Press, 1997

[29] **Bassford, Christopher:** *Clausewitz in English, The Reception of Clausewitz in Britain and America 1815-1945,* Oxford University Press, 1994

[30] **Baylis, John and Smith, Steve and Owens, Patricia (eds.):** *The Globalisation of World Politics*, Oxford University Press, 2007

[31] **Baylis, John and Wirtz, James and Cohen, Eliot and Gray, Colin S. (eds.):** *Strategy in the Contemporary World, An Introduction to Strategic Studies,* Oxford University Press, 2002
[32] **Beaumont, Roger:** *War, Chaos, and History,* Praeger Publishers, 1994
[33] **Boggs, Carl (ed.):** *Masters of War, Militarism and Blowback in the Era of American Empire,* Routledge, 2003
[34] **Brenner, Sydney and Miller, Jeffrey H.:** *Encyclopedia of Genetics,* Volume 1, Academic Press, 2001
[35] **Briggs, John and Peat, David F.:** *Turbulent Mirror, An Illustrated Guide to Chaos Theory and the Science of Wholeness*, Harper & Row, 1989
[36] **Brocades Zaalberg, Thijs W.:** *Soldiers and Civil Power, Supporting or Substituting Civil Authorities in Modern Peace Operations*, Amsterdam University Press, 2006
[37] **Brodie, Bernard (ed.):** *The Absolute Weapon, Atomic Power and World Order,* Hartcourt, Brace and Company, 1946
[38] **Brodie, Bernard:** *Strategy in the Missile Age,* Princeton University Press, 1959
[39] **Brown, Seyom:** *The Illusion of Control, Force and Foreign Policy in the 21st Century,* Brookings Institution Press, 2003
[40] **Brown, Shona L. and Eisenhardt, Kathleen M.:** *Competing on the Edge, Strategy as Structured Chaos,* Harvard Business School Press, 1998
[41] **Buchler, Justus:** *Metaphysics of Natural Complexes*, Columbia University Press, 1966
[42] **Budiansky, Stephen:** *Air Power, From Kitty Hawk to Gulf War II: A History of the People, Ideas and Machines that Transformed War in the Century of Flight,* Penguin Books, 2003
[43] **Builder, Carl H.:** *The Masks of War, American Military Styles and Strategy and Analysis,* RAND Corporation Research Study, The John Hopkins University Press, 1989
[44] **Byman, D. L. and Waxman M. C. and Larson, E. V.:** *Air Power as Coercive Instrument,* RAND MR-1061-AF, 1999
[45] **Byman, D. and Lesser, I. and Bruce, P. and Benard, C. and Waxman, M.:** *Strengthening the Partnership, Improving Military Coordination with Relief Agencies and Allies in Humanitarian Operations,* RAND MR-1185-AF, 2000
[46] **Byman, Daniel and Waxmann, Matthew:** *The Dynamics of Coercion, American Foreign Policy and the Limits of Military Might,* Cambridge University Press, 2002
[47] **Capra, Fritjof:** *The Web of Life, A New Scientific Understanding of Living Systems,* Anchor Books Doubleday, 1997
[48] **Central Intelligence Agency:** *The World Fact Book 2004,* Internet, accessed 08. 03. 2004, available at www.cia.gov/cia/publications/factbook/geos/iz.html#People
[49] **Cerami, Joseph R. and Holcomb, James F. (eds.):** *U.S. Army War College Guide to Strategy,* U.S. Army War College, 2001, Internet, accessed 08. 03. 2005, available at http://permanent.access.gpo.gov/lps11754/00354.pdf
[50] **Cilliers, Paul:** *Complexity and postmodernism, Understanding complex systems*, Routledge, 1998
[51] **Cimbala, Stephen J.:** *Clausewitz and Chaos, Friction and Military Policy,* Praeger Publishers, 2001
[52] **Cimbala, Stephen J.:** *Coercive Military Strategy,* Texas A&M University Press, 1998
[53] **Clausewitz, Carl von:** *On War,* Everyman's Library, 1993

[54] **Cleland, David I.:** *Project Management, Strategic Design and Implementation,* TAB Professional and Reference Books, 1990

[55] **Clippinger, John H. III. (ed.):** *The Biology of Business, Decoding the Natural Laws of Enterprise,* Jossey-Bass Publishers, 1999

[56] **Clodfelter, Mark:** *The Limits of Air Power, The American Bombing of North Vietnam,* The Free Press, 1989

[57] **Coker, Christopher:** *Waging War Without Warriors, The Changing Culture of Military Conflict,* IISS Studies In International Security, Lynne Rienner Publishers Inc, 2002

[58] **Corum, James S. and Johnson, Wray R.:** *Air Power in Small Wars, Fighting Insurgents and Terrorists,* University Press of Kansas, 2003

[59] **Coveney, Peter and Highfield, Roger:** *Frontiers of Complexity, The Search for Order in a Chaotic World*, faber and faber, 1995

[60] **Coveney, Peter and Highfield, Roger:** *The Arrow of Time, The Quest to Solve Science's Greatest Mistery*, Flamingo, 1991

[61] **Cramer, Friedrich:** *Chaos and Order, The Complex Structure of Living Systems,* VCH Verlagsgesellschaft, 1993

[62] **Crawford, Natalie and Moon Chung-in (eds.):** *Emerging Threats, Force Structures, and the Role of Air Power in Korea,* RAND CF-152-AF, 2000

[63] **Creveld, Martin van:** *Command in War*, Harvard University Press, 1985

[64] **Creveld, Martin van:** *Fighting Power, German and U.S. Army Performance, 1939-1945*, Greenwood Press, 1982

[65] **Creveld, Martin van:** *The Transformation of War,* The Free Press, 1991

[66] **Crook, Paul:** *Darwinism, war and history, The debate over the biology of war from the 'Origin of Species' to the First World War,* Cambridge University Press, 1994

[67] **Czerwinski, Tom:** *Coping with the Bounds, Speculations on Nonlinearity in Military Affairs,* CCRP Publication Series, January 1998

[68] **Darwin, Charles R.:** *On the Origin of Species, By Means of Natural Selection, Or the Preservation of Favoured Races in the Struggle for Life*, John Murray, 1859

[69] **Darwin, Charles R.:** *The Descent of Man, And Selection in Relation to Sex*, John Murray, 1871

[70] **Davis, Paul K.:** *Analytic Architecture for Capabilities-Based Planning, Mission-System Analysis, and Transformation*, RAND MR-1513, 2002

[71] **Davis, Paul K.:** *Effects Based Operations (EBO): A Grand Challenge for the Analytical Community,* RAND MR-1477, 2001

[72] **Dockery, John T. and Woodcock, A. E. R.:** *The Military Landscape, Mathematical Models of Combat,* Woodhead Publishing Limited, 1993

[73] **Douhet, Giulio:** *The Command of the Air,* New Imprint by the Office of Air Force History, Washington D. C., 1983

[74] **Dupuy, T. N. (Col.):** *Understanding War, History and Theory of Combat*, Leo Cooper, 1987

[75] **Dupuy, T. N.:** *A Genius for War*, Macdonald and Jane's, 1977

[76] **Earle, Edward M.:** *Makers of Modern Strategy*, Princeton University Press, 1943

[77] **Edwards, Sean J. A. :** *Swarming on the Battlefield: Past, Present, and Future,* RAND MR-1100-OSD, 2000

[78] **Edwards, Sean J. A.:** *Swarming and the Future of Warfare*, Dissertation, Pardee RAND Graduate School, 2004
[79] **Ehrenreich, Barbara:** *Blood Rites: Origins and History of the Passions of War*, Metropolitan Books, 1997
[80] **Emme, Eugen M. (ed.):** *The Impact of Air Power, National Security and World Politics,* D. Van Nostrand Company, 1959
[81] **Emmet, Dorothy:** *The Effectiveness of Causes,* Macmillan, 1984
[82] **Freedman, Lawrence (ed.):** *Strategic Coercion, Concepts and Cases,* Oxford University Press, 1998
[83] **Gale, Richard:** *Blackwell Guide to Metaphysics,* Blackwell, 2002
[84] **Gell-Mann, Murray:** *The Quark and the Jaguar, Adventures in the Simple and the Complex,* Little Brown and Company, New York, 1994
[85] **George, Alexander L. and Simons, William E. (eds.):** *The Limits of Coercive Diplomacy,* Westview Press, 1994
[86] **Goertzel, Ben:** *From Complexity to Creativity Computational Models of Evolutionary, Autopoietic and Cognitive Dynamics,* Internet, accessed 11. 12. 2006, available at http://goertzel.org/books/complex/contents.html
[87] **Gleick, James:** *Chaos, Making a New Science,* Viking Penguin Inc., 1987
[88] **Gödel, Kurt:** *On Formally Undecidable Propositions of Principia Mathematica and Related Systems*, Basic Books, 1962
[89] **Goldmann, Kjell:** *The Logic of Internationalism, Coercion and Accommodation,* Routledge London and New York, 1994
[90] **Gordon, Michael R. and Trainor, Bernard E. (Gen.):** *The General's War, The Inside Story of Conflict in the Gulf,* Little, Brown and Company, 1995
[91] **Gove, Philip B. (ed. i. ch.):** *Webster's Third New International Dictionary of the English Language,* Unabridged, Merriam-Webster Inc., 1981
[92] **Grant, Robert M.:** *Contemporary Strategy Analysis, Concepts, Techniques, Applications,* Blackwell Publishers, 2002
[93] **Gray, Chris H.:** *Postmodern War, The New Politics of Conflict,* Routledge London, 1997
[94] **Hahlweg, K. and Hooker, C. A. (eds.):** *Issues in Evolutionary Epistemology*, State University of New York Press, 1989
[95] **Hallion, Richard P. (ed.):** *Air Power Confronts and Unstable World,* Brassey's, 1997
[96] **Hammes, Thomas X.:** *The Sling and the Stone, On War in the 21st Century,* Zenith Press, 2004
[97] **Handel, Michael I.:** *Clausewitz and Modern Strategy,* Frank Cass, 1986
[98] **Hobbes, Thomas:** *Leviathan,* Oxford University Press, 1996
[99] **Hanson, Victor D.:** *Carnage and Culture: Landmark Battles in the Rise to Western Power,* Anchor, 2001
[100] **Hardt, Michael and Negri, Antonio:** *Multitude: War and Democracy in the Age of Empire*, Penguin Press, 2004
[101] **Holland, John H.:** *Emergence, From Chaos To Order,* Oxford University Press, 1998
[102] **Holland, John H.:** *Hidden Order, How Adaptation Builds Complexity,* Helix Books, 1995
[103] **Horvich, Paul:** *Asymmteries of Time, Problems in the Philosophy of Science,* MIT Press Classic Series, 1987

[104] **Hosmer, Stephen T.:** *Psychological Effects of U.S. Air Operations in Four Wars 1941-1991, Lessons for U.S. Commanders,* RAND MR-576-AE, 1996
[105] **Hume, David:** *A Treatise of Human Nature,* Oxford University Press, 1978
[106] **Ilachinski, Andrew:** *Land Warfare and Complexity, Part I: Mathematical Background and Technical Sourcebook,* Center for Naval Analyses, CIM 461, July 1996a
[107] **Ilachinski, Andrew***: Land Warfare and Complexity, Part II: An Assessment of the Applicability of Nonlinear Dynamics and Complex Systems Theory to the Study of Land Warfare (U),* Center for Naval Analyses, CRM 96-68, July 1996b
[108] **Jervis, Robert and Lebow, Ned R. and Stein, Janice G.:** *Psychology and Deterrence,* The John Hopkins University Press, 1985
[109] **Johnson, D. E. and Mueller, K. P. and Taft, W. H.:** *Conventional Coercion Across the Spectrum of Operations, The Utility of U.S. Military Forces in the Emerging Security Environment,* Arroyo Center, RAND MR-1494, 2002
[110] **Jomini, Baron Antoine Henri de:** *The Art of War,* Greenhill Books, London, Stackpole Books, Pennsylvania, 1992
[111] **Josephus:** *The Jewish War,* Penguin Books, 1959
[112] **Kaufmann, Stuart:** *At Home in the Universe, The Search for Laws of Self-Organisation and Complexity,* Oxford University Press, 1995
[113] **Kaufmann, Stuart:** *The Origins of Order: Self-Organization and Selection in Evolution,* Oxford University Press, 1992
[114] **Keegan, John:** *A History of Warfare,* Pimlico, The Random House Group Limited, 1994
[115] **Kelly, Kevin:** *Out of Control, The Rise of Neo-Biological Civilisation*, Addison-Wesley Publishing Company, 1994
[116] **Kiel, L. Douglas and Elliott, Euel (eds.):** *Chaos Theory in the Social Sciences, Foundations and Applications,* The University of Michigan Press, 1996
[117] **Knox, MacGregor and Murray, Williamson:** *The Dynamics of Military Revolution 1300-2050,* Cambridge University Press, 2001
[118] **Kuhn, Thomas S.:** *The Structure of Scientific Revolutions,* International Encyclopedia of Unified Science, Foundations of the Unity of Science, Volume 2, Number 2, 1962
[119] **Kumar, Krishan:** *From Post-Industrial to Post-Modern Society, New Theories for the Contemporary World*, Blackwell, 1995
[120] **Lee, Bradford A. and Walling, Karl F. (eds.):** *Strategic Logic and Political Rationality: Essays in Honor of Michael I. Handel,* Frank Cass, 2003
[121] **Liddel Hart, Basil H.:** *Paris or The Future of War,* E. P. Dutton & Company, 1925
[122] **Liddel Hart, Basil H.:** *Strategy,* Frederick A. Praeger Publishers, 1967
[123] **Liddel Hart, Basil H.:** *The Revolution in Warfare,* Faber and Faber Ltd., 1946
[124] **Liddel Hart, Basil H.:** *Thoughts on War,* Spellmount Staplehurst, 1999
[125] **Liddel Hart, Basil H.:** *Through the Fog of War,* Faber and Faber Ltd., 1938
[126] **Lorenz, Edward N.:** *The Essence of Chaos*, UCL Press, 1993
[127] **Luttwak, Edward N.:** *Strategy, The Logic of War and Peace,* Revised and Enlarged Edition, The Belknap Press of Harvard University Press, 2001
[128] **Lyotard, Jean-François:** *The Postmodern Condition: A Report on Knowledge*, University of Minnesota Press, 1984
[129] **Machiavelli, Niccolo:** *Art of War,* The University of Chicago Press, 2003

[130] **Mansfield, Sue:** *The Gestalts of War, An Inquiry into Its Origins and Meanings as a Social Institution,* The Dial Press, 1982
[131] **McGill, Michael E. and Slocum, John W.:** *The Smarter Organisation, How to Build a Business that Learns and Adapts to Marketplace Needs,* John Wiley & Sons, 1994
[132] **Millet, Allan R. and Murray, Williamson:** *Military Effectiveness, Volumes I-III*, Allen & Unwin, 1988
[133] **Mintzberg, H. and Ahlstrand, B. and Lampel, J.:** *Strategy Safari, A Guided Tour Through the Wilds of Strategic Management,* The Free Press, 1998
[134] **Mintzberg, Henry:** *Mintzberg on Management: Inside Our Strange World of Organisations,* The Free Press, 1989
[135] **Mintzberg, Henry:** *The Rise and Fall of Strategic Planning,* Prentice Hall, 1994
[136] **Mitchell, William:** *Memoirs of World War I,* Greenwood Press, 1975
[137] **Mitchell, William:** *Winged Defense, The Development and Possibilities of Modern Air Power – Economic and Military,* G. P. Putnam's Sons, 1925
[138] **Moffat, James:** *Complexity Theory and Network Centric Warfare,* Information Age Transformation Series, CCRP Publication Series, September 2003
[139] **Morgenbesser, S. and Suppes, P. and White, M.:** *Philosophy, Science and Method, Essays in Honor of Ernest Nagel,* St. Martin's Press, 1969
[140] **Nagel, Ernest:** *The Structure of Science, Problems in the Logic of Scientific Explanation,* Hackett Publishing Company, 1979
[141] **Neilson, Robert E. (ed.):** *Sun Tzu and Information Warfare, A collection of winning papers from the Sun Tzu Art of War in Information Warfare Competition*, National Defense University Press, 1997
[142] **Nicolis, Grégoire and Prigogine, Iliya:** *Exploring Complexity, An Introduction,* W. H. Freeman and Company New York, 1989
[143] **O'Hanlon, Michael:** *Technological Change and the Future Warfare,* Brookings Institution Press, 2000
[144] **Osinga, Frans:** *Science, Strategy and War, The Strategic Theory of John Boyd,* Eburon Academic Publishers, 2005
[145] **Overy, Richard J.:** *The Air War 1939-1945,* Stein and Day Publishers, 1981
[146] **Overy, Richard J.:** *Why the Allies Won,* W. W. Norton and Company, 1995
[147] **Owens, William A.:** *Lifting the Fog of War,* Farrar, Straus and Giroux, 2000
[148] **Pape, Robert A.:** *Bombing to Win, Air Power and Coercion in War,* Cornell University Press, 1996
[149] **Paret, Peter:** Paret, Peter (ed.): *Makers of Modern Strategy, From Machiavelli to the Nuclear Age,* Princeton University Press, 1986
[150] **Perret, Geoffrey:** *Winged Victory, The Army Air Forces in World War II,* Random House, 1993
[151] **Perrow, Charles:** *Normal Accidents, Living with High-Risk Technologies,* Basic Books, 1984
[152] **Peters, Ralph:** *Fighting for the Future, Will America Triumph?* Stackpole Books, 1999
[153] **Pick, Daniel:** *War Machine, The Slaughter in the Modern Age,* Yale University Press, 1993
[154] **Poincaré, Henry:** *The Foundations of Science, Science and Hypothesis, The Value of Science, Science and Method*, University Press of America, 1982

[155] **Pollack, Kenneth M.:** *Arabs at War: Military Effectiveness, 1948-1991,* CFR Book, 2002
[156] **Potts, David (ed.):** *The Big Issue: Command and Combat in the Information Age*, Strategic and Combat Studies Institute, February 2003
[157] **Prigogine, Ilya and Stengers, Isabelle:** *Order Out of Chaos, Man's New Dialogue with Nature,* Heinemann, 1984
[158] **Rhodes, Edward:** *Power and MADness, The Logic of Nuclear Coercion,* Columbia University Press, 1989
[159] **Robbins, Stephen P.:** *Organization Theory: Structure, Design, and Applications,* Prentice-Hall International Editions, 1987
[160] **Rosenbaum, Alan S.:** *Coercion and Autonomy, Philosophical Foundations, Issues, And Practices,* Greenwood Press, 1986
[161] **Schelling, Thomas C.:** *Arms and Influence,* Greenwood Press, 1976
[162] **Schelling, Thomas C.:** *The Strategy of Conflict,* Harvard University, 1997
[163] **Seversky, Alexander P. de (Maj.):** *Victory through Air Power,* Simon and Schuster, 1942
[164] **Sherry, Michael S.:** *The Rise of American Air Power, The Creation of Armageddon,* Yale University Press, 1987
[165] **Shultz, Richard H. Jr. and Pfaltzgraff, Robert L. Jr.:** *The Future of Air Power in the Aftermath of the Gulf War,* Air University Press, July 1992
[166] **Sills, David I. (ed.):** International Encyclopedia of the Social Sciences, Volume 16, New York Macmillan & The Free Press, 1972
[167] **Simpson, Christopher:** *Science of Coercion, Communication Research and Psychological Warfare 1945-1960,* Oxford University Press, 1994
[168] **Slessor, John C.:** *Air Power and Armies,* Oxford University Press, 1936
[169] **Slessor, John C.:** *Strategy for the West*, Cassell and Company Ltd., 1954
[170] **Slessor, John C.:** *The Central Blue, Recollections and Reflections,* Cassell and Company Ltd., 1956
[171] **Smith, Edward A.:** *Complexity, Networking and Effects-Based Approaches to Operations*, CCRP Publication Series, May 2006
[172] **Smith, Edward A.:** *Effects Based Operations, Applying Network Centric Warfare in Peace, Crisis, and War,* CCRP Publication Series, November 2002
[173] **Snyder, Craig A. (ed.):** *Contemporary Security and Strategy,* Macmillan Press, 1999
[174] **Stacey, Ralph D.:** *Strategic Management & Organisational Dynamics*, Pitman Publishing, 1996
[175] **Staden, Alfred von and Rood, Jan and Labohm, Hans:** *Cannons and Canon, Clingendael Views of Global and Regional Politics,* Royal van Gorkum, 2003
[176] **Stein, Daniel L. (ed.):** *Lectures in the Sciences of Complexity,* Addison-Wesley Publishing Company, 1989
[177] **Sulis, W. and Combs, A. (eds.):** *Nonlinear Dynamics in Human Behaviour*, World Scientific, 1996
[178] **Sun Tse:** *L'art de la guerre, Traduit du chinois par le pére Amiot,* Éditions Didot Faîné, Paris, 1772
[179] **Tenner, Edward:** *Why Things Bite Back: Technology and the Revenge of Unintended Consequences,* Alfred A. Knopf Inc., 1996
[180] **Thaler, David E.:** *Strategies to Tasks: A Framework for Linking Means and Ends,* RAND MR-300-AF, 1993

[181] **Toffler, Alvin and Toffler, Heidi:** *War and Anti-War, Survival at the Dawn of the 21st Century,* Little, Brown and Company, 1993
[182] **Toffler, Alvin:** *The Third Wave,* Bantam Books, 1980
[183] **Treverton, Gregory F.:** *Framing Compellent Strategies,* RAND MR-1240-OSD, 2000
[184] **Tzu, Sun:** *The Art of War,* Shambhala Dragon Editions, Shambhala Publications Inc., 1988
[185] **Waldrop, Mitchell M.:** *Complexity, The Emerging Science at the Edge of Order and Chaos,* Viking 1992
[186] **Warden, John A. (Col.):** *The Air Campaign, Planning for Combat,* Pergamon-Brassey's International Defense Publishers, 1989
[187] **Wheatley, Margaret J.:** *Finding Our Way, Leadership for an Uncertain Time*, Berrett-Koehler Publishers, 2005
[188] **Wijk, Rob de***: The Art of Military Coercion, Why the West's Military Superiority Scarcely Matters,* Mets & Schilt, 2005
[189] **Williams, Garnett P.:** *Chaos Theory Tamed,* Taylor & Francis, 1997
[190] **Wylie, Joseph C.:** *Military Strategy: A General Theory of Power Control*, Naval Institute Press, 1967
[191] **Xenophon:** *Anabasis*, Harvard University Press, 2001

THESES/MONOGRAPHS/BRIEFINGS

[192] **Barlow, Jason B. (Maj.):** *Strategic Paralysis, An Airpower Theory for the Present,* School of Advanced Airpower Studies, Air University, May 1992
[193] **Batschelet, Allen W. (Lt. Col.):** *Effects-Based Operations: A New Operational Model?,* U.S. Army War College, 2002
[194] **Beagle, T. W.:** *Effects-Based Targeting: Another Empty Promise?* School of Advanced Airpower Studies, Air University, June 2000
[195] **Biddle, Stephen:** *Afghanistan and the Future of Warfare: Implications for Army and Defense Policy,* Strategies Studies Institute, U.S. Army War College, November 2002
[196] **Boyd, John:** *Patterns of Conflict,* Manuscript, December 1986, Internet, accessed 15. 06. 2005, available at www.d-n-i.net/boyd/pdf/poc.pdf
[197] **Burkett, Wendy H.:** *Assessing the Results of Effects-Based Operations (EBO): The Relationship Between Effects-Based Operations and the Psychological Dimension of Warfare*, U.S. Army War College, 07 April 2003
[198] **Castellano, Francis X. (Lt. Com.):** *Effects-Based Command and Control: An Alternative Organizational Structure for the Joint Force Commander,* Naval War College, 03 February 2003
[199] **Cheek, Gary H. (Col.):** *Effects-Based Operations: The End of Dominant Maneuver?,* U.S. Army War College, 09 April 2002
[200] **Cordesman, Anthony H.:** *The Military Effectiveness Of Desert Fox: A Warning About the Limits of the Revolution in Military Affairs and Joint Vision 2010,* Center for Strategic and International Studies, 26 December 1998
[201] **Deptula, David A. (Brig. Gen.):** *Effects-Based Operations: Change in the Nature of Warfare,* Aerospace Education Foundation, Defense and Airpower Series, 1995

[202] **DuBuis, Edmond and Hughes, Wayne P. Jr. and Low, Lawrence J.:** *A Concise Theory of Combat*, Institute for Joint Warfare Analysis, Naval Postgraduate School, October 1998, Internet, accessed 19. 05. 2005, available at www.militaryconflict.org/Concise%20Theory.htm

[203] **Duczynski, Guy A:** *To what extent can knowledge management systems build and reinforce consensus around initiatives for change?: A self-reflective analysis of professional practice*, Ph. D. thesis, Edith Cowan University, November 2001

[204] **Durham, Susanne E. (Maj., Ph. D.):** *Chaos Theory For The Practical Military Mind,* Air Command and Staff College, March 1997

[205] **Felker, Edward J. (Lt. Col.):** *Airpower, Chaos and Infrastructure, Lords of the Rings,* Air War College, Air University, Maxwell Paper No. 14, Maxwell AFB , July 1998

[206] **Finney, Robert T.:** *History of the Air Corps Tactical School 1920-1940,* Research Studies Institute, USAF Historical Division, Air University, March 1955

[207] **Gleeson, Dennis J. and Linde Gwen (Col.) and McGrath, Kathleen and Murphy, Adrianne J. and Murray, Williamson and O'Leary, Tom and Resnick, Joel B.:** *New Perspectives on Effects-Based Operations: Annotated Briefing,* Institute for Defense Analyses, Joint Advance Warfighting Program, June 2001

[208] **Goure, Leon:** *Some Impressions of the Effects of Military Operations on Viet Cong Behaviour,* RAND RM-4517-ISA, August 1965

[209] **Gray, Colin S.:** *Weapons for Strategic Effect, How Important is Technology?,* Occasional Paper Number 21, Center for Strategy and Technology, Air War College, Air University, January 2001

[210] **Hinman IV, Ellwood P. "Skip" (Lt. Col.):** *The Politics of Coercion, Toward a Theory of Coercive Airpower for Post-Cold War Conflict,* CADRE Paper No. 14, Air University Press, August 2002

[211] **Ho, Joshua:** *The Advent of a New Way of War: Theory and Practice of Effects Based Operations,* Working Paper Series No. 57, Institute of Defence and Strategic Studies, Singapore, December 2003

[212] **Hoekema, David A.:** *Rights and Wrongs: The Justification of Coercion and Punishment,* Ph. D. thesis, Princeton University, February 1981, Authorised Facsimile by University of Microfilms International, Ann Arbor, Michigan, USA, 1985

[213] **Hordijk, Wim:** *Population Flow on Fitness Landscapes*, Erasmus University Rotterdam, August 1994

[214] **James, Glenn E.:** *Chaos Theory, The Essentials for Military Applications,* The Newport Papers, Naval War College, October 1996

[215] **Kent, Glenn A. and Simons, William E.:** *A Framework for Enhancing Operational Capabilities,* RAND R-4043-AF, 1991

[216] **Kent, Glenn A.:** *Concepts of Operations: A More Coherent Framework for Defense Planning,* RAND N-2026-AF, 1983

[217] **Kolenda D. Christopher (Maj.):** *Uncertainty in War: Exploring the Nature of Combat and Conflict*, Advanced Research Project, Naval War College, February 2002

[218] **Kreighbaum, Jay M. (Maj.):** *Force Application Planning: A System-and-Effects-Based Approach,* School of Advanced Airpower Studies, Air University, June 1998

[219] **Low, Lawrence J.:** *Anatomy of a Combat Model*, Review Copy, Internet, accessed 19. 05 2006, available at www.militaryconflict.org/Anatomy%20of%20a%20Combat%20Model

[220] **Mann, Edward (Col., Ret.) and Endersby, G. (Lt. Col., Ret.) and Searle, Tom:** *Thinking Effects, Effects-Based Methodology for Joint Operations,* College for Aerospace Doctrine, Research and Education, Air University, CADRE Papers No. 15, October 2002

[221] **Meilinger, Philip S. (Col.):** *Airmen and Air Theory, A Review of the Sources,* Air University Press, 2001

[222] **Murray, Williamson:** *Thoughts on Effects-Based Operations, Strategy, and the Conduct of War*, Institute for Defense Analysis, January 2004

[223] **Peatland, Pat A. (Lt. Col.):** *Center of Gravity Analysis and Chaos Theory,* Air War College, Air University, April 1993

[224] **Pirnie, Bruce and Gardiner, Sam B.:** *An Objectives-Based Approach to Military Campaign Analysis,* RAND MR656-JS, 1996

[225] **Polumbo, Harry D. (Col.):** *Effects-based Air Campaign Planning: The Diplomatic Way to solve Air Power's Role in the 21st Century,* Air War College, Air University, Air Force Academy, April 2000

[226] **Rinaldi, Steven M. (Maj.):** *Beyond the Industrial Web, Economic Synergies and Targeting Methodologies,* School of Advanced Airpower Studies, Air University Press, April 1995

[227] **Sakulich, Timothy J. (Lt. Col.):** *Precision Engagement on the Strategic Level of War: Guiding Promise of Wishful Thinking*, Occasional Paper Number 25, Air University, December 2005

[228] **Seow Hiang (Maj.):** *Center of Gravity or Center of Confusion, Understanding the Mistique,* Air Command and Staff College, Air University, Maxwell AFB, Wright Flyer Paper No. 10, December 1999

[229] **Steblin, Mark E. (Lt. Col.):** *Targeting for Effects: Is There an Iceberg Ahead?* Air War College, Air University, April 1997

[230] **Teo, Jason T. W.:** *Pareto Multi-objective Evolution of Legged Embodied Organisms,* University of New South Wales - Australian Defence Force Academy, Ph. D. Thesis, 2003

[231] **Thaler, David E. and Shlapak, David A.:** *Perspectives on Theater Air Campaign Planning,* RAND MR-515-AF, 1995

[232] **Wainwright, David, J. (Maj.):** *Should The Australian Army Adopt The Concept of Effects-Based Operations?* US Army Command and General Staff College, Forth Leavenworth, 2003

[233] **Walker, Scott G. (Maj.***): Targeting for Effect, Analytical Framework for Counterland Operations*, School of Advanced Airpower Studies, Air University Press, May 1998

[234] **Wall, Stephen J. and Wall, Shannon R.:** *The New Strategists, Creating Leaders at All Levels,* The Free Press, 1995

[235] **Waller, J. W. (Wing Com.):** *Effects-Based Operations and the Royal Australian Air Force,* Aerospace Centre, Paper Number 11, August 2003

[236] **Watts, Barry D.:** *Clausewitzian Friction and the Future War,* McNair Paper 68, Institute for National Strategic Studies, National Defence University, 2004

[237] **West, Scott D.:** *Warden and the Air Corps Tactical School, Déjà vu?,* School of Advanced Airpower Studies, Air University Press, October 1999

[238] **Whittemore, David M. (Maj.):** *Modelling Strategic Effects in Wargames,* Air Command and Staff College, Air University, April 1999

[239] **Williams, Brett T. (Col.):** *Effects-Based Operations: Theory, Application and the Role of Airpower,* U.S. Army War College, Carlisle Barracks, 09 April 2002

WHITE PAPERS/CONCEPT PAPERS/MANUALS

[240] **Air Combat Command:** *Effects-Based Operations*, White Paper, May 2002
[241] **Allied Command Transformation***: Integrated Project Teams,* 7 September 2004
[242] **Australian Defence Force:** *Effects Based Operations, Discussion Paper,* Directorate of Future Warfighting Concepts, 2003
[243] **Department of Defense:** *Joint Publication 1-02, Dictionary of Military and Associated Terms,* 12 April 2001 (As Amended Through 31 August 2005), Internet, accessed 01. 03. 2005, available at www.dtic.mil/doctrine/jel/new_pubs/jp1_02.pdf
[244] **Department of Defense:** *Quadrennial Defense Review,* 2001
[245] **Department of Defense**: *Report of the Quadrennial Defense Review,* May 1997, Internet, accessed 19. 05. 2003, available at www.fas.org/man/docs/qdr/msg.html
[246] **Department of Defense:** *Report on the Bottom-Up Review,* October 1993, Internet, accessed 19. 05. 2003, available at www.fas.org/man/docs/bur/index.html
[247] **Department of Defense:** *The 2006 Quadrennial Defense Review Report,* 6 February 2006
[248] **Field Manual 100-20:** *Command and Employment of Air Power,* War Department, 21 July 1943
[249] **Janssen, Heidi J. W. and Toevank, Freek-Jan G. and Smeenk, Belinda J. E. and Voskuilen, Marion J. M.:** *Psychological Operations, Considerations on its Measurement of Effectiveness*, TNO-FEL Concept Paper, 09. 11. 2003
[250] **Joint Chiefs of Staff:** *Joint Vision 2010,* July 1996
[251] **Joint Chiefs of Staff:** *Joint Vision 2020,* June 2000 (text only version – jv2020.doc), Internet, accessed 26. 10. 2004, available at http://www.dtic.mil/jointvision/jvpub2.htm
[252] **Ministry of Defence:** *British Air Power Doctrine, AP 3000, Third Edition,* Her Majesty's Stationary Office, 1999
[253] **NATO Strategic Commanders:** *Strategic Vision: The Military Challenge,* MC 324/1, as of 12. 01. 2003, Internet, accessed 17. 01. 2005, available at
[254] **U.S. Marine Corps:** *MCDP 1 Warfighting,* 20 June 1997
[255] **USJFCOM J9:** *A Concept for Rapid Decisive Operations,* Whitepaper Version 2.0, as of 22. 08. 2001
[256] **USJFCOM J9:** *A Concept Framework for Effects-Based Operations,* White Paper Version 1.0, as of 18. 10. 2001
[257] **USJFCOM JED:** *The Multinational Effects-Based Operations Process (CONOPS),* Version 0.65, 7 January 2005, Internet, accessed 04. 03. 2005, available at www.act.nato.int/events/seminars/05mne4etodevloews1.htm

ARTICLES/PROCEEDINGS/LECTURES

[258] **Ackoff, Russel T.:** *Fundamentalism and Panaceas,* Systemic Practice and Action Research, Volume 14, Number 1, 2001, pp. 3-10
[259] **Alchian, Armen A.:** *Uncertainty, Evolution, and Economic Theory,* The Journal of Political Economy, Volume 58, Number 3, June 1950, pp. 211-221
[260] **Alterman, Eric:** *The Uses and Abuses of Clausewitz*, Parameters, Summer 1987, pp. 18-32

[261] **Andreski, Stanislav:** *Evolution and War*, Science Journal, January 1971, pp. 89-92
[262] **Arkin, William M.:** *A New Mindset for Warfare,* Washingtonpost, 22 September 2001, Internet, accessed 25. 03. 2003, available at www.washingtonpost.com/ac2/wp-dyn/A8672-201Sep22
[263] **Armstrong, Robert E. and Warner, Jerry B.:** *Biology and the Battlefield,* Defense Horizons, Number 25, March 2005
[264] **Arthur, Brian W.:** *Competing Technologies, Increasing Returns, and Lock-in by Historical Events,* The Economic Journal, March 1989, pp. 116-131
[265] **Arthur, Brian W.:** *Positive Feedbacks in the Economy,* Scientific American, February 1990, pp. 92-99
[266] **Atkine, Norville de:** *Why Arabs Lose Wars*, MERIA Journal, Volume 4, Number 1, March 2000, Internet, accessed 12. 05. 2006, available at www.meria.biu.ac.il/journal/2000/issue1/jv4n1a2.html
[267] **Barber, Benjamin:** *Jihad vs. McWorld,* The Alantic Monthly, Volume 269, Number 3, March 1992, pp. 53-65
[268] **Bassford, Christopher:** *John Keegan and the Grand Tradition of Trashing Clausewitz,* Internet, accessed 16. 12. 2004, available at www.clausewitz.com/CWZHOME/Keegan/KEEGWHOL.htm
[269] **Bailey, L. H.:** *War and Biology*, The Journal of Heredity, Volume 6, Number 2, 1915, pp. 51-64
[270] **Beinhocker, Eric D.:** *On the Origins of Strategies,* The McKinsey Quarterly, Number 4, 1999, pp. 46-57
[271] **Beinhocker, Eric D.:** *Robust Adaptive Strategies,* MIT Sloan Management Review, Spring 1999, pp. 95-106
[272] **Beinhocker, Eric D.:** *Strategy at the Edge of Chaos,* The McKinsey Quarterly, Number 1, 1997, pp. 24-39
[273] **Belote, Howard, D. (Maj.):** *Warden and the Air Corps Tactical School, What Goes Around Comes Around,* Airpower Journal, Fall 1999, pp. 39-47
[274] **Bence, Christopher (Maj.):** *Warden vs. Pape,* Preface, Air & Space Power Chronicles, Internet, accessed 29. 04. 2003, available at www.airpower.maxwell.af.mil/airchronicles/cc/bence/html
[275] **Betts, Richard K.:** *Is Strategy an Illusion?* International Security, Volume 25, Number 2, 2000, pp. 5-50
[276] **Beyerchen, Alan D.:** *Clausewitz, Nonlinearity and the Unpredictability of War,* Internet, accessed 02. 08. 2005, available at www.clausewitz.com/CWZHOME/Beyerchen/CWZandNonlinearity.htm
[277] **Biddle, Stephen and Long, Stephen:** *Democracy and Military Effectiveness, A Deeper Look*, Journal of Conflict Resolution, Volume 48, Number 4, August 2004, pp. 525-546
[278] **Biddle, Stephen:** *Afghanistan and the Future of Warfare,* Foreign Affairs, March-April 2003, pp. 31-46
[279] **Bingham, Price T. (Lt. Col. Ret.):** *Air Power Targeting Theory: A Key Element in Transformation,* Military Review, May-June 2002, Internet, accessed 16. 09. 2003, available at www-cgsc.army.mil/milrev/□axwell/MayJune02/bingham.asp
[280] **Bingham, Price T. (Lt. Col., Ret.):** *Transforming Warfare with Effects-Based Joint Operations,* Aerospace Power Journal, Spring 2001, pp. 58-66

[281] **Bingham, Price T.***: Seeking Synergy, Joint Effects-Based Operations,* Joint Forces Quarterly, Spring 2002, pp. 52-59

[282] **Binnedijk, Hans:** *A Strategic Assessment for the 21st Century,* Joint Force Quarterly, Autumn 1996, pp. 67-68

[283] **Brabazon, Tony and Matthews, Robin:** *Organisational Adaptation on Rugged Landscapes,* Internet, accessed 15. 02. 2004, available at

[284] **Brodie, Bernard:** *Strategy as a Science,* World Politics, Volume 1, Number 4, 1949, pp. 567-488

[285] **Brodie, Bernard:** *The Influence of Mass Destruction Weapons on Strategy,* Lecture before the Army War College, RAND P-669, 21 March 1955

[286] **Burridge, Brian:** *Technical Development and Effects Based Operations,* 2004 Trenchard Memorial Lecture, RUSI Journal, October 2004, pp. 26-28

[287] **Cebrowski, Arthur K. (Vice Adm.) and Garstka, John J.:** *Network-Centric Warfare: Its Origins and Future*, Proceedings, January 1998, Internet, accessed 14. 06. 2006, available at www.usni.org/Proceedings/Articles98/PROcebrowski.htm

[288] **Chakravarthy, Bala:** *A New Strategy Framework for Coping with Turbulence,* MIT Sloan Management Review, Winter 1997, pp. 69-82

[289] **Cheng, Patricia W.:** *From Covariation to Causation: A Causal Power Theory,* Psychological Review, Volume 104, Number 2, 1997, pp. 367-405

[290] **Chisholm, Donald:** *The Risk of Optimism in the Conduct of War,* Parameters, Winter 2003/04, pp. 114-131

[291] **Christensen, Clayton M. and Raynor, Michael E.:** *Why Hard-Nosed Executives Should Care About Management Theory*, Harvard Business Review, September 2003, pp. 67-74

[292] **Cole, Leon J.:** *Biological Philosophy and the War,* The Scientific Monthly, Volume 8, Issue 3, 1919, pp. 247-257

[293] **Collins, Steven:** *Army PSYOP in Bosnia: Capabilities and Constraints*, Parameters, Summer 1999, pp. 57-73

[294] **Cooper, Scott A.:** *Air Power and the Coercive Use of Force,* The Washington Quarterly, Autumn 2001, pp. 81-93

[295] **Courtney, Hugh and Kirkland Jane and Vigueri, Patrick:** *Strategy Under Uncertainty,* Harvard Business Review, November-December 1997, pp. 67-79

[296] **Courtney, Hugh:** *Making the Most of Uncertainty,* The McKinsley Quarterly, Internet, accessed 22. 03. 2005, available at http://www.mckinseyquarterly.com/article_abstract.aspx?ar=1128&L2=21&L3=37&srid=10&gp=1

[297] **Crane, Conrad:** *Effects-Based Operations: A Blast From the Past,* Commentary, Defense Week, 14 May 2001, p. 16

[298] **Crawley, James W.:** *Rising War Costs, Monthly War Spending Passes $ 5.8 Billion,* Media General News Service, Internet, accessed 01. 12. 04, available at www.globalsecurity.org/org/news/2004/041119-iraq-burn-rate.htm

[299] **Daven, Choy (Capt.):** *Effects-Based Operations: Obstacles and Opportunities,* Journal of the Singapore Armed Forces, Volume 30, Number 2, 2004, Internet, accessed 31. 08. 2004, available at http://www.mindef.gov.sg/safti/pointer/back/journals/2004/Vol30_2/3.htm

[300] **Denny, Anthony, D.:** *U.S. Air Force Uses New Tools to Minimize Civilian Casualties,* Internet, accessed 20. 08. 2003, available at www.stratwise.com/countries_us_civ_casualties.htm

[301] **Dent, Eric B.:** *Complexity Science: a Worldview Shift,* Emergence, 1999, Vol. 1, Issue 4, pp. 5-19

[302] **Deptula, David A. (Brig. Gen.):** *Firing For Effects,* Air Force Magazine, Volume 84, Number 4, April 2001, Internet, accessed 21. 03. 2003, available at www.afa.org/magazine/April2001/0401effects_print.htm

[303] **Deptula, David A. (Maj. Gen.):** *Effects-Based Operations: A US Perspective,* World Defence Systems, The Royal United Services Institute, Volume 6, Number 2, August 2003, pp. 37-41

[304] **Deptula, David A.:** *Air Force Transformation, Past, Present, and Future,* Aerospace Power Journal, Fall 2001, Internet, accessed 02. 04. 2003, available at www.airpower.maxwell.af.mil/airchronicles/apj/apj01/fal01/phifal01.htm

[305] **Diamond, Larry:** *What Went Wrong in Iraq,* Foreign Affairs, Internet, accessed 25. 01. 2007, available at www.foreignaffairs.org/20040901faessay83505/larry-diamond/what-went-wrong-in-iraq.htm

[306] **Dorff, Robert H.:** *Democratization and Failed States: The Challenge of Ungovernability,* Parameters, Summer 1996, pp. 17-31

[307] **Dosi, Giovanni and Levinthal, Daniel A. and Marengo, Luigi:** *Bridging contested terrain: linking incentive-based and learning perspectives on organisational evolution,* Industrial and Corporate Change, Volume 12, Number 2, 2003, pp. 413-436

[308] **Drapeau, Mark D. and Hurley, Peyton C. and Armstrong Robert E.:** *So Many Zebras, So Little Time: Ecological Models and Counterinsurgency Operations*, Defense Horizons, Number 62, February 2008, pp. 1-8

[309] **Dunlap, Charles J. Jr.:** *21st Century Land Warfare: Four Dangerous Myths,* Parameters, Autumn 1997, pp. 27-37

[310] **Echevarria, Antulio J. II (Maj.):** *War, Politics, and RMA – The Legacy of Clausewitz,* Joint Force Quarterly, Winter 1995/96, pp. 76-80

[311] **Eisenhardt, Kathleen M. and Sull, Donald N.:** *Strategy as Simple Rules,* Harvard Business Review, January 2001, pp.107-116

[312] **Eisenhardt, Kathleen M.:** *Has Strategy Changed?* MIT Sloan Management Review, Winter 2002, pp. 88-91

[313] **Elkins, David J. and Simeon, E. B.:** *A Cause in Search of its Effect, or What Does Political Culture Explain?*, Comparative Politics, January 1979, pp. 127-145

[314] **Emery, F. E. and Trist, E. L.:** *The Causal Texture of Organizational Environments*, Human Relations, Number 18, 1965, pp. 21-32

[315] **Emery, Frederick E.:** *Methodological Premises of Social Forecasting,* in: Annals of the American Academy of Political and Social Science, Volume 412, The Information Revolution, March 1974, pp. 97-115

[316] **Emmeche, Claus and Køppe, Simo and Stjernfelt, Frederik:** *Explaining Emergence: Towards an Ontology of Levels*, Journal for General Philosophy of Science, Volume 28, 1997, pp. 83-119

[317] **Endersbury, Garry (Lt. Col.) and Fulbright, Barry (Lt. Col):** *Effects-Based Airpower,* Internet, accessed 27. 09. 2002, available at www.airpower.maxwell.af.mil/airchronicles/apj/apj98/win98/waywin98.html

[318] **Evans, A. and Graham, S. and Jones, E. K. and Pioch, N. and Prendergast, M. and White, C. M.:** *Strategy Development for Effects-Based Planning,* ALPHATEC Inc., Internet, accessed 24. 17. 2003, available at www.mors.org/meetings/ebo/ebo_reads/White_Strategy.pdf

[319] **Faber, Peter (Lt. Col.):** *Competing Theories of Airpower: A Language for Analysis*, Internet, accessed 15. 06. 2004, available at www.airpower.maxwell.af.mil/airchronicles/presentation/faber.html

[320] **Faber, Peter (LT. Col.):** *The Development of US Strategic Bombing Doctrine in the Interwar Years: Moral and Legal?* Journal of Legal Studies, 1996/1997, Internet, accessed 14. 07. 2005, available at www.au.af.mil/au/awc/awcgate/interwar/faberdbd.htm

[321] **Fabyanic, Thomas A. (Col. Ret.):** *War, Doctrine, and the Air War College, Some Relationships and Implications for the US Air Force,* Air University Review, January-February 1986, Internet, accessed 28. 06, 2004, available at www.airpower.maxwell.af.mil/airchronicles/aureview/1986/jan-feb/fabyanic.html

[322] **Farjoun, Moshe:** *Towards and Organic Perspective on Strategy,* Strategic Management Journal, 2002, pp. 561-594

[323] **Feld, M. D.:** *Information and Authority: The Structure of Military Organization,* American Sociological Review, Volume XXIV, 1959, pp. 15-22

[324] **Ferris, John and Handel, Michael I.:** *Clausewitz, Intelligence, Uncertainty and the Art of Command in Military Operations*, Intelligence and National Security, Volume 10, Number 1, pp. 1-58

[325] **Fleming, Bruce:** *Can Reading Clausewitz Save Us from Future Mistakes?* Parameters, Spring 2004, pp. 62-76

[326] **Flood, Robert L.:** *Knowing the Unknowable*, Systemic Practice and Action Research, Volume 12, Number 3, 1999, pp. 247-256

[327] **Folland G. and Sitaram A.:** *The Uncertainty Principle: A Mathematical Survey*, Journal of Fourier Analysis and Applications, 1997, pp. 207-238

[328] **Foster, Gregory D.:** *The Postmodern Military, The Irony of "Strengthening" Defense,* Harvard International Review, Summer 2001, pp. 24-29

[329] **Franz, Silvio and Peliti, Luca:** *Error threshold in simple landscapes,* Journal of Physics A: Mathematical and General, Volume 30, Number 13, pp. 4481-4487

[330] **Friedman, George-:** *The Unpredictability of War and Force Structure,* The STRATFOR Weekly, 29 September 2003, Internet, accessed 12. 08. 2005, available at www.vialardi.org/IRAQ/unpredictability_of_war.html

[331] **Fuchs, Christian:** *Structuration Theory and Self-Organization, Systemic Practice and Action Research*, Volume 16, Number 2, April 2003, pp. 133-167

[332] **Gallois, Pierre:** *1967: The Triumph of Vertical Warfare,* Geopolitique, Number 22, Summer 1988, pp. 17-19

[333] **Geeraerts, Gustaaf:** *Non-Linearity, Chaos and the Predictability of War,* Pole Paper, Volume 4, Number 1, January 1998, Internet, accessed 02. 08. 2005, available at www.poli.vub.ac.be/publi/pole-papers/pole0401.htm

[334] **Geus, Arie P. de:** *Planning and Learning, At Shell planning means changing minds, not making plans,* Harvard Business Review, March-April 1988, pp. 70-74
[335] **Goldstein, Jeffrey:** *Emergence as a Construct: History and Issues*, Emergence, Volume 1, Issue 1, 1999, pp. 49-72
[336] **Goldstein, Joshua A.:** *The Emperor's New Genes: Sociobiology and War*, International Studies Quarterly, Issue 31, 1987, pp. 33-43
[337] **Gomory, Ralph E.:** *The Known, the Unknown and the Unknowable,* Essay, Scientific American, June 1995, p. 88
[338] **Goold, Michael:** *Research Notes and Communications Design, Learning and Planning: A Further Observation on the Design School Debate,* 1992, Strategic Management Journal, pp. 169-170
[339] **Grant, Robert M.:** *Strategic Planning in a Turbulent Environment: Evidence from the Oil Majors,* Strategic Management Journal, Volume 24, 2003, pp. 491-517
[340] **Gray, Colin S.:** *Comparative Strategic Culture,* Parameters, Winter 1984
[341] **Green, David G. and Newth, David:** *Towards a theory of everything? – Grand challenges in complexity and informatics*, Complexity International, Volume 8, 2001, p. 1, Internet, accessed 25. 10. 2005, available at http://journal-ci.csse.monash.edu.au/ci/vol08/green05/
[342] **Griffin, Douglas and Shaw, Patricia and Stacey, Ralph:** *Knowing and Acting in Conditions of Uncertainty: A Complexity Perspective*, Systemic Practice and Action Research, Volume 16, Number 2, April 2003, pp. 295-309
[343] **Grove, A. S.:** *Navigating Strategic Inflection Points*, Business Strategic Review, Volume 8, Number 3, 1997, p. 11-18
[344] **Hallman, Wesley P.:** *Airpower and Psychological Denial,* Joint Force Quarterly, Issue 37, pp. 33-39
[345] **Hamel, Gary:** *Strategy as Revolution,* Harvard Business Review, July-August 1996, pp. 69-82
[346] **Hammond, Grant T. Dr.:** *Myths of the Air War over Serbia, Some "Lessons" Not to Learn,* Aerospace Power Journal, Winter 2000, pp. 78-86
[347] **Hammond, Grant T. Dr.:** *Myths of the Gulf War, Some "Lessons" Not to Learn,* Airpower Journal, Fall 1998, pp. 6-18
[348] **Hanson, Victor D.:** *Postmodern War,* City Journal, Winter 2005, Internet, accessed 08. 03. 2005, available at www.city-journal.org/html/15_1_postmodern_war.html
[349] **Harkabi, Y.:** *Basic Factors in the Arab Collapse During the Six-Day War*, Orbis, Fall 1967, pp. 677-691
[350] **Herman, Mark:** *Entropy-Based Warfare: Modeling the Revolution in Military Affairs,* Joint Forces Quarterly, Autumn/Winter 1998-99, pp. 85-90
[351] **Hinen, Anthony L. (Col.):** *Kosovo: "The limits of Air Power II",* Air and Space Power Chronicles, Internet, accessed 09. 03. 2005, available at www.airpower.maxwell.af.mil/airchronicles/cc/hinen.html
[352] **Ho How Hoang, Joshua (Lt. Col.):** *Effects-Based Operations Equals to "Shock And Awe"?,* Journal of the Singapore Armed Forces, Volume 30, Number 2, 2004, Internet, accessed 30. 08. 2004, available at http://www.mindef.gov.sg/safti/pointer/back/journals/2004/Vol30_2/7.htm
[353] **Hooker, R. D. Jr.:** *Beyond Vom Kriege: The Character and Conduct of Modern War,* Parameters, Summer 2005, pp. 4-17

[354] **Howard, Michael:** *The Forgotten Dimensions of Strategy,* Foreign Affairs, Summer 1979, pp. 975-986
[355] **Huntington, Samuel:** *The Clash of Civilizations?,* Foreign Affairs, Summer 1993, pp. 22-49
[356] **Huss, Jon (Maj.):** *Exploiting the Psychological Effects of Air Power, A Guide for the Operational Commander,* Aerospace Power Journal, Winter 1999, pp. 23-32
[357] **Jablonsky, David:** *Time's Arrow, Time's Cycle: Metaphors for a Period of Transition*, Parameters, Winter 1997-98, pp. 4-27
[358] **Johnson, Eric:** *WAR in the Media: Metaphors, Ideology, and the Formation of Language Policy,* Bilingual Research Journal, Volume 29, Number 3, Fall 2005, pp. 621-640
[359] **Joshi, Amitabh:** *The Shifting Balance Theory of Evolution,* Resonance, December 1999, pp. 66-75
[360] **Kamp, Christen and Bornholdt, Stefan:** *Coevolution of Quasispecies: B-Cell Mutation Rates Maximize Viral Error Catastrophes,* Physical Review Letters, Volume 88, Number 6, pp. 068104-1-4
[361] **Kan, Paul R. Dr.:** *What Should We Bomb? Axiological Targeting and the Abiding Limits of Airpower Theory,* Air Power Review, Volume 7, Number 3, 2004, pp. 31-33
[362] **Kanter, Rosabeth Moss:** *Strategy as Improvisional Theater,* MIT Sloan Management Review, Winter 2002, pp. 76-81
[363] **Kaplan, Robert A.:** *"The Coming Anarchy" and the Nation-State under Siege,* Peaceworks, Number 4, United States Institute of Peace, 1995, pp. 5-12
[364] **Kauffman, Stuart A.:** *Antichaos and Adaptation,* Scientific American, August 1991, pp. 64-81
[365] **Kaufmann, S. A. and Levin S.:** *Towards a General Theory of Adaptive Walks on Rugged Landscapes,* Journal of Theoretical Biology, Issue 128, 1987, pp. 11-45
[366] **Kaufmann, Stuart A. and Lobo, José and Macready, William G.:** *Optimal Search on a technology landscape,* Journal of Economic Behaviour & Organization, Volume 43, 2000, pp. 141-166
[367] **Kaufmann, Stuart A. and Macready, William G.:** *Technological Evolution and Adaptive Organisations, Ideas from biology may find applications in economics,* Complexity, 1995, pp. 26-43
[368] **Kaufmann, Stuart A.:** *Technology and Evolution, Escaping the Red Queen Effect,* The McKinsey Quarterly, Number 1, 1995, pp. 119-129
[369] **Keaney, Thomas A.:** *Surveying Gulf War Airpower*, Joint Force Quarterly, Autumn 1993, pp. 25-36
[370] **Khalil, Elias L.:** *Natural Complex vs. Natural System,* Journal of Social and Biological Structures, Volume 13, Number 1, 1990, pp. 11-31
[371] **Khan, Farzana:** *The Arab-Israeli War,* Pakistan Horizon, Third Quarter 1967, pp. 259-273
[372] **Kibble, David G.:** *The Attacks of 9/11: Evidence of a Clash of Religions?*, Parameters, Autumn 2002, pp. 34-45
[373] **Klinger, Janeen:** *The Social Science of Carl von Clausewitz,* Parameters, Spring 2006, pp. 79-89
[374] **Krulak, Charles G. (Gen.):** *The Strategic Corporal: Leadership in the Three Block War,* Marines Corps Gazette, Volume 83, Number 1, January 1999, Internet, accessed 16. 08. 2005, available at www.au.af.mil/au/awc/awcgate/usmc/ strategic_corporal.htm

[375] **Kurtz, Cynthia F. and Snowden, David J.:** *The new dynamics of strategy: Sense–making in a complex and complicated world*, IBM Systems Journal, Volume 42, Number 3, 2003, pp. 462-482
[376] **Kuruc, Anton:** *The Relevance of Chaos Theory to Operations,* Australian Defence Force Journal, Number 162, September-October 2003, pp. 4-16
[377] **Lambert, Andrew (Air Com.):** *The Future of Air Power,* RUSI Journal, 2003, pp. 46-53
[378] **Langenheim, William S. (Capt.):** *Give Peace a Chance, First Try Coercive Diplomacy,* Naval War College Review, Autumn 2002, pp. 50-71
[379] **Laroque, Emma:** *The Metis in English Canadian Literature,* The Canadian Journal of Native Studies, Volume III, Number I, 1983, pp. 85-94
[380] **Lazarus, David B.:** *Effects-Based Operations and Counterterrorism,* Air & Space Power Journal, Fall 2005, Internet, accessed 14. 10. 2005, available at www.airpower.maxwell.af.mil/airchronicles/apj/apj05/fal05/lazarus.html
[381] **Lefebvre, Eric and Letiche, Hugo:** *Managing Complexity from Chaos: Uncertainty, Knowledge and Skills*, Emergence, Volume 1, Number 3, 1999, pp. 7-15
[382] **Levin, Simon A.:** *Complex Adaptive Systems: Exploring the Known, the Unknown and the Unknowable,* Bulletin of the American Mathematical Society, Volume 40, Number 1, 2003, pp. 3-19
[383] **Levin, Simon A.:** *Ecosystems and the Biosphere as Complex Adaptive Systems*, Ecosystems, Number 1, 1998, pp. 431-436
[384] **Levinthal, Daniel A.:** *Adaptation on Rugged Landscapes,* Management Science, Volume 43, Number 7, July 1997, pp. 935-950
[385] **Levinthal, Daniel A.:** *Organizational Adaptation and Environmental Selection – Interrelated Processes of Change,* Organization Science, Volume 2, Number 1, February 1991, pp. 140-145
[386] **Lewis, Bernard:** *The Arab-Israeli War, The Consequences of Defeat,* Foreign Affairs, Volume 46, January 1968, pp. 321-335
[387] **Liddel Hart, B. H.:** *The Ratio of Troops to Space*, Military Review, April 1960, pp. 3-14
[388] **Lind, William S. et. al.:** *The Changing Face of War: Into the Fourth Generation,* Marine Corps Gazette, November 2001, pp. 22-26
[389] **Lindblom, Charles E.:** *The Science of "Muddling Through",* Public Administration Review, Spring 1959, pp. 79-88
[390] **Liotta, P. H.:** *Chaos as Strategy,* Parameters, Summer 2002, pp. 47-56
[391] **Lissack, Michael R.:** *Complexity: the Science, its Vocabulary, and its Relation to Organizations*, Emergence, Volume 1, Issue 1, 1999, pp. 110-125
[392] **Loeb, J.:** *Biology and War*, Science, Volume 45, Issue 1152, 1917, pp. 73-76
[393] **Lopez, Antonio M. and Comello, Jerome J. and Cleckner, William H.:** *Machines, the Military, and Strategic Thought,* Military Review, September-October 2004, pp. 71-77
[394] **Luehrman, Timothy A.:** *Strategy as Portfolio of Real Options,* Harvard Business Review, September-October 1998, pp. 89-99
[395] **Luttwak, Edward N.:** *Toward Post-Heroic Warfare,* Foreign Affairs, May, June 1995, pp. 109-122
[396] **MacGregor, Douglas A.:** *Command and Control for Joint Strategic Actions*, Joint Force Quarterly, Autumn/Winter 1998-99, pp. 25-33

[397] **Macintosh, Robert and Maclean Donald:** *Conditioned Emergence: A Dissipative Structures Approach to Transformation,* Strategic Management Journal, 1999, pp. 297-316

[398] **Mankins, Michael C. and Steele, Richard:** *Stop Making Plans; Start Making Decisions,* Harvard Business Review, January 2006, pp. 76-84

[399] **Mann, Edward (Col., Ret.) and Endersby, G. (Lt. Col., Ret.) and Searle, Tom:** *Dominant Effects: Effects-Based Joint Operations,* Aerospace Power Journal, Fall 2001, Internet, accessed 27. 09. 2002, available at www.airpower.maxwell.af.mil/airchronicles/apj/apj01/vorfal01.html

[400] **Mann, Edward (Lt. Col.):** *One Target, One Bomb, Is the Principle of Mass Dead?*, Airpower Journal, Internet, accessed 10. 03. 2005, available at www.airpower.maxwell.af.mil/airchronciles/apj.mann.html

[401] **March, James G.:** *Exploration and Exploitation in Organizational Learning,* Organization Science, Volume 2, Number 1, February 1991, pp. 71-87

[402] **Markides, Constantinos C.:** *A Dynamic View of Strategy*, MIT Sloan Management Review, Spring 1999, pp. 55-63

[403] **Matthen, Mohan and Ariew, Andre:** *Two Ways of Thinking About Fitness and Natural Selection,* The Journal of Philosophy, February 2002, pp. 55-83

[404] **McKelvey, Bill:** *Avoiding Complexity Catastrophe in Coevolutionary Pockets: Strategies for Rugged Landscapes,* Organization Science, Volume 10, Number 3, May-June 1999, pp. 294-321

[405] **McNicoll, Iain:** *Effects-Based Operations: Air Command and Control and the Nature of the Emerging Battlespace,* RUSI Journal, June 2003, p. 38

[406] **McPeak, Merrill A.:** *A Neater Way to Winn,* Response, Foreign Affairs, September-October 2004, pp. 160-162

[407] **Meilinger, Philip S.:** *The Origins of Effects-Based Operations,* Joint Force Quarterly, Issue 35, pp. 116-122

[408] **Meilinger, Phillip S. (Col.):** *Air Strategy, Targeting for Effects,* Air Power Journal, Winter 1999, pp. 48-61

[409] **Merry, Uri:** *Organizational Strategy on Different Landscapes: A New Science Approach,* Systemic Practice and Action Search, Volume 12, Number 3, 1999, pp. 257-278

[410] **Merton, Robert K.:** *The Unanticipated Consequences of Purposive Social Action,* American Sociological Review, December 1936, pp. 894-904

[411] **Metz, Stephen:** *A Wake for Clausewitz: Toward a Philosophy of 21st-Century Warfare*, Parameters, Winter 1994-95, pp. 126-132

[412] **Meyer, Christopher:** *Survival Under Stress,* MIT Sloan Management Review, Volume 44, Number 1, Fall 2002, p. 16

[413] **Millett, Allan R. and Murray, Williamson:** *Lessons of War,* The National Institute, Winter 1988/89, pp. 83-95

[414] **Mintzberg, H. and Waters J. A.:** *Of Strategies, Deliberate and Emergent,* Strategic Management Journal, Volume 6, 1985, pp. 257-272

[415] **Mintzberg, Henry and Lampel, Joseph:** *Reflecting on the Strategy Process,* MIT Sloan Management Review, Spring 1999, pp. 21-30

[416] **Mintzberg, Henry and McHugh, Alexandra:** *Strategy Formation in an Adhocracy,* Administrative Science Quarterly, 30, 1985, pp. 160-197

[417] **Mintzberg, Henry:** *Crafting Strategy,* Harvard Business Review, July-August 1987, pp. 66-75
[418] **Mintzberg, Henry:** *Patterns in Strategy Formation*, Management Science, Volume 24, Number 9, May 1978, pp. 934-948
[419] **Mintzberg, Henry:** *Reply to Michael Goold,* California Management Review, Volume 38, Number 4, Summer 1996, pp. 96-99
[420] **Mintzberg, Henry:** *The Design School: Reconsidering the Basic Premises of Strategic Management,* Strategic Management Journal, Volume 11, 1990, pp. 171-195
[421] **Mitchell, Sandra D.:** *Function, Fitness and Disposition,* Biology and Philosophy, Volume 10, 1995, pp. 39-54
[422] **Mitman, Gregg:** *The Biology of Peace*, Biology and Philosophy, Number 12, 1997, pp. 259-264
[423] **Modelski, George and Poznanski, Kazimierz:** *Evolutionary Paradigms in the Social Sciences*, International Studies Quarterly, Volume 40, 1996, pp. 315-319
[424] **Molderez, Ingrid:** *Freedom and Uncertainty*, Emergence, Volume 1, Issue 3, 1999, pp. 84-91
[425] **Moncrieff, J.:** *Is Strategy Making a Difference?,* Long Range Planning, Volume 32, Number 2, 1999, pp. 273-276
[426] **Mueller, Karl Dr.:** *The Essence of Coercive Air Power: A Primer for Military Strategists,* Air & Space Power Chronicles, Internet, accessed 15. 06. 2004, available at www.airpower.maxwell.af.mil/airchronicles/cc/mueller.html
[427] **Mueller, Karl:** *Strategies of Coercion: Denial, Punishment and the Future of Air Power,* Security Studies 7, Number 3, Spring 1998, pp. 182-228
[428] **Murphy, Timothy G. (Lt. Col.):** *A Critique of the Air Campaign,* Aerospace Power Journal, Spring 1994, Internet, accessed 14. 04. 2003, available at www.airpower.au.af.mil/airchronicles/apj/apj94/murphy.html
[429] **Murray, William S.:** *A Will to Measure*, Parameters, Autumn 2001, pp. 134-147
[430] **Murray, Williamson:** *Clausewitz Out, Computer In, Military Culture and Technological Hubris*, The National Interest, Summer 1997, Internet, accessed 15. 05. 2006, available at www.clausewitz.com/CWZHOME/Clause&Computers.html
[431] **Murray, Williamson:** *Military Culture Does Matter*, Strategic Review, Spring 1999, pp. 32-40
[432] **Murray, Williamson:** *Thinking About Revolutions in Military Affairs*, Joint Forces Quarterly, Summer 1997, pp. 69-76
[433] **Nicholls, David (Maj.) and Tagarev, Todor (Maj.):** *What Does Chaos Theory Mean for Warfare?*, Aerospace Power Journal, Fall 1994, Internet, accessed 10. 12. 2003, available at www.airpower.maxwell.af.mil/airchronicles/apj/apj94/nichols.html
[434] **Nielsen, Suzanne C.:** *Civil-Military Relations Theory and Military Effectiveness*, Public Administration and Management, Volume 10, Number 2, 2005, pp. 61-84
[435] **Noedskov, K. (Maj.):** *Systematizing Effect Based Air Operations,* Air & Space Power Chronicles, Internet, accessed 27. 09. 2002, available at www.airpower.maxwell.af.mil/airchronicles/cc/noedskov.html
[436] **Nye, Joseph S. Jr.:** U.S. *Power and Strategy After Iraq,* Foreign Affairs, July-August 2003, pp. 62-63
[437] **Ovington, C. O.:** *War and Evolution*, The Westminster Review, April 1900, p. 411-420

[438] **Pape, Robert A.:** *Coercion and Military Strategy: Why Denial Works and Punishment Doesn't,* Journal of Strategic Studies, Volume 15, Number 4, December 1992, pp. 423-475
[439] **Pape, Robert A.:** *The Air Force Strikes Back: A Reply to Barry Watts and John Warden,* Security Studies 7, Number 2, Winter 1997/98, pp. 191-214
[440] **Pape, Robert A.:** *The True Worth of Air Power,* Foreign Affairs, March-April 2004, pp. 116-130
[441] **Parker, Christopher S.:** *New Weapons for Old Problems, Conventional Proliferation and Military Effectiveness in Developing States*, International Security, Volume 23, Number 4, Spring 1999, pp. 119-147
[442] **Pascale, Richard T.:** *Surfing the Edge of Chaos,* MIT Sloan Management Review, Spring 2003, pp. 83-94
[443] **Peach, Stuart (Air Com.):** *Effects-Based Operations: The Contemporary Air Perspective,* Air Power Review, Autumn 2003, pp. 27-47
[444] **Pearce, LeRoy J. Dr.:** *Coalition Operations in the Global Village,* Internet, accessed 27. 10. 2005, available at www.aiai.ed.ac.uk/project/coalition/ksco/ksco-1999/DOC/pearce-c-ops-global-village.doc
[445] **Pendall, David P. (Maj.):** *Effects-Based Operations and the Exercise of National Power,* Military Review, January-February 2004, pp. 20-31
[446] **Perry, James D.:** *Air Corps Experimentation in the Interwar Years – A Case Study,* Joint Forces Quarterly, Summer 1999, pp. 42-50
[447] **Peters, Ralph:** *Our New Old Enemies,* Parameters, Summer 1999, pp. 22-37
[448] **Peters, Ralph:** *The Culture of Future Conflict,* Parameters, Winter 1995-96, pp. 18-27
[449] **Peters, Ralph:** *The New Warrior Class,* Parameters, Summer 1994, pp. 16-26
[450] **Pfaff, Charles A. (Maj.):** *Chaos, Complexity and the Battlefield,* Military Review, July August 2000, pp. 83-86
[451] **Pigeau, Ross, Dr. and McCann, Carol:** *Re-Conceptualising Command and Control*, Canadian Military Journal, Spring 2002, pp. 53-63
[452] **Plutynski, Anya:** *Explanatory Unification and the Early Synthesis,* British Journal for the Philosophy of Science, Volume 56, 2005, pp. 595-609
[453] **Pool, Robert:** *Chaos Theory: How Big an Advance?,* Science, Volume 245, July 1989, pp. 26-28
[454] **Quinn, James Brian:** *Strategy, Science and Management,* MIT Sloan Management Review, Summer 2002, p. 96
[455] **Read, Robyn:** *Effects-Based Airpower for Small Wars,* Air & Space Power Journal, Spring 2005, Internet, accessed 17. 08. 2005, available at www.airpower.maxwell.af.mil/airchronicles/apj/apj05/spr05/read.html
[456] **Record, Jeffrey:** *Sizing Up Military Effectiveness*, Parameters, December 1988, pp. 25-29
[457] **Reimer, Dennis J.:** *Dominant Maneuver and Precision Engagement,* Joint Forces Quarterly, Winter 1996-97, pp. 13-16
[458] **Reisch, George A.:** *Chaos, History and Narrative,* History and Theory, Winter 1991, pp. 1-20
[459] **Reiter, Dan and Stam, Allan C. III.:** *Democracy and Battlefield Effectiveness*, Journal of Conflict Resolution, Volume 42, Number 3, June 1998, pp. 259-277
[460] **Richards, Diana:** *Is Strategic Decision Making Chaotic?,* Behavioral Science, Volume 35, 1990, pp. 219-232

[461] **Richardson, Kurt A. and Lissack, Michael R.:** *On the Status of Boundaries, both Natural and Organisational: A Complex Systems Perspective,* Emergence, Volume 3, Issue 4, 2001, pp. 32-49

[462] **Rittel, Horst W. and Webber, Melvin M.:** *Dilemmas in a General Theory of Planning, Policy Sciences,* 4/1973, pp. 155-169

[463] **Rivkin, Jan W.:** *Imitation of Complex Strategies,* Management Science, Volume 46, Number 6, June 2000, pp. 824-844

[464] **Roos, Johan and Oliver, David:** *From Fitness Landscapes to Knowledge Landscapes,* Systemic Practice and Action Research, June 1999, pp. 279-293

[465] **Rosé, Helge:** *Complexity of Fitness Landscapes,* Proceeding, International Conference on Complex Systems, Noshua, USA, 21-26. 09. 1997, Internet, accessed 11. 08. 2005, available at www.first.fraunhofer.de/publikationen?prID=1167&von=mitarbeiter

[466] **Rosen, Stephen Peter:** *Military Effectiveness, Why Society Matters*, International Security, Volume 19, Number 4, Spring 1995, pp. 5-31

[467] **Rubel, Robert C.:** *The Epistemology of War Gaming,* Naval War College Review, Volume 59, Number 2, Spring 2006, pp. 108-128

[468] **Russ, Marion and Bacon, Josh:** *Organizational Extinction and Complex Systems*, Emergence, Volume 1, Issue 4, 1999, pp. 71-96

[469] **Saperstein, Alvin M.:** *Chaos – a model for the outbreak of war,* Nature, 24 May 1984, pp. 303-305

[470] **Saperstein, Alvin M.:** *The "Long Peace" – Result of a Bipolar Competitive World,* Journal of Conflict Resolution, Volume 35, Number 1, March 1991, pp. 68-79

[471] **Saperstein, Alvin M.:** *War and Chaos,* American Scientist, November-December 1995, pp. 548-557

[472] **Saunders-Newton, Desmond and Frank, Aaron B.:** *Effects-Based Operations: Building the Analytic Tools,* Defense Horizons, October 2002, Internet, accessed 18. 04. 2003, available at www.ndu.edu/inss/DefHor/DH19/DH_19

[473] **Scales, Robert H. Jr.:** *Adaptive Enemies, Achieving Victory by Avoiding Defeat*, Joint Force Quarterly, Autumn/Winter 1999-2000, pp. 7-14

[474] **Schnaubelt, Christopher M.:** *Can The Military's Effectiveness in the Drug War be Measured?* The Cato Journal, Volume 14, Number 2, Fall 1994, Internet, accessed 12. 05. 2006, available at www.cato.org/pubs/journal/cjv14n2-5.html

[475] **Skinner, Tony:** *NATO endorses effects-based approach*, Jane's Defence Weekly, 26 April 2006, p. 5

[476] **Smalter, Donald J. and Ruggles, Rudy L.:** *Six Business Lessons from The Pentagon,* Harvard Business Review, March-April 1966, pp. 64-75

[477] **Smith, Alistair:** *Fighting Battles, Winning Wars*, Journal of Conflict Resolution, Volume 42, Number 3, June 1998, pp. 301-320

[478] **Snowden, David and Stanbridge, Peter:** *The Landscape of Management: Creating the context for understanding social complexity*, ECO Special Double Issue, Volume 6, Number 1-2, Fall 2004, pp. 140-148

[479] **Snowden, David:** *The Paradox of Story*, Scenario and Strategy Planning, Volume 1, Issue 5, November 1999, pp. 16-20

[480] **Soonthornkit, Saridporn (Wing. Com.):** *Sun Tzu, Strategic Paralysis and Small Nations,* Air Power Review, Volume 4, Number 4, 2001, pp. 40-46

[481] **Speight L. R.:** *Lanchester's Equation And The Structure of the Operational Campaign: Between-Campaign Effects,* Military Operations Research, Volume 7, Number 2, 2002, pp. 15-33

[482] **Speight, L. R.:** *'Structural Variance' or 'Non-Monotonicity' Effects in Combat Models: A Review,* Military Operations Research, Volume 8, Number 1, 2003, pp. 17-33

[483] **Sproles, Noel, Dr.:** *Dissecting Command and Control with Occam's Razor or Ask not what "Command" and "Control" means to you but what you mean by "Command and Control"*, Australian Defence Force Journal, No. 155, July-August 2002, pp. 19-26

[484] **Stephenson, Alan J.:** *Shades of Gray: Gradual Escalation and Coercive Diplomacy,* in: Chairman of the Joint Chiefs of Staff Strategy Essay Competition, Essays 2002, NDU Press, Washington D. C. 2002, pp. 1-20

[485] **Steven R.:** *Chaos Theory and Strategic Thought,* Parameters, Autumn 1992, pp. 54-68

[486] **Storr, Jim:** *A Critique of Effects-Based Thinking*, RUSI Journal, December 2005, pp. 32-35

[487] **Swenson, David X. and Rigoni, David:** *Ethical Problem Solving and Systems Theory: The Complexity Connection*, Systemic Practice and Action Research, Volume 12, Number 6, 1999, pp. 573-584

[488] **Tasaka, Hiroshi Dr.:** *Twenty-first-century Management and the Complexity Paradigm,* Emergence, 1999, Volume 1, Issue 4, pp. 115-123

[489] **Thomas, Timothy L.:** *The Battle of Grozny: Deadly Classroom for Urban Combat,* Parameters, Summer 1999, pp. 87-102

[490] **Tomes, Robert:** *Relearning Counterinsurgency Warfare,* Parameters, Spring 2004, pp. 16-28

[491] **Tucker, David:** *Fighting Barbarians,* Parameters, Summer 1998, pp. 69-79

[492] **Valentin, Marcel (Gen.):** *Military Effectiveness in the Face of Terrorism*, Le Figaro, Monday 23 January 2006, translated by Leslie Thatcher, Internet, accessed 21. 03. 2006, available at www.truthout.org/cgi-bin/artman/exec/view.cgi/48/17158

[493] **Vayda, Andrew P.:** *Warfare in Ecological Perspective*, Annual Review of Ecology and Systematics, Volume 5, 1974, pp. 183-193

[494] **Vego, Milan N.:** *Effects-Based Operations: A Critique*, Joint Force Quarterly, Issue 41, 2nd Quarter 2006, pp. 51-57

[495] **Vego, Milan N.:** *Operational Command and Control in the Information Age*, Joint Force Quarterly, Issue 35, pp. 100-107

[496] **Vego, Milan N.:** *The Problem of Common Terminology*, Joint Force Quarterly, Issue 43, 4th Quarter 2006, pp. 44-49

[497] **Vergata, Antonello la:** *Evolution and War, 1871-1918*, Nuncius, Volume 9, Number 1, 1994, pp. 143-163

[498] **Wallace, William S. (Lt. Gen.):** *Network Enabled Battle-Command*, Military Review, May-June 2005, pp. 2-5

[499] **Warden, John A. (Col.):** *The Enemy as a System,* Airpower Journal, Spring 1995, Internet, accessed 22. 05. 2003, available at www.airpower.maxwell.af.mil/airchronicles/apj/spr95.html

[500] **Warden, John A. III.:** *Success in Modern War, A Response to Robert Pape's Bombing to Win,* Security Studies 7, Number 2, Winter 1997/98, pp. 172-190

[501] **Warden, John:** *The New American Security Force,* Airspace Power Journal, Fall 1999, Internet, accessed 22. 05. 2003, available at www.airpower.maxwell.af.mil/airchronicles/apj/apj99/fal99/vorfal99.html

[502] **Ware, Lewis Dr.:** *Ware on Warden, Some Observations of the Enemy as a System,* Airpower Journal, Winter 1995, Internet, accessed 07. 06. 2004, available at www.airpower.maxwell.af.mil/airchronicles/apj/ware.html

[503] **Weeks, Michael R. (Maj.):** *Chaos, Complexity and Conflict,* Air & Space Power Chronicles, Internet, accessed 22. 05. 2003, available at www.airpower.maxwell.af.mil/airchronicles/cc/Weeks.html

[504] **Wegman, Yehuda:** *Israel's Security Doctrine and the Trap of "Limited Conflict",* Military Technology, March 2005, pp. 86-96

[505] **Weinberger, Ed:** *Correlated and Uncorrelated Fitness Landscapes and How to Tell the Difference,* Biological Cybernetics, Volume 63, 1990, pp. 325-336

[506] **Wheatley, Margaret and Kellner-Rogers, Myron:** *What Do We Measure and Why? Questions About the Uses of Measurement*, Journal for Strategic Performance Measurement, June 1999, Internet, accessed 19. 05. 2006, available at http://www.margaretwheatley.com/articles/whymeasure.html

[507] **Whitehead, Stuart A. (Col.):** *Battle Command, Toppling the Tower of Babel*, Military Review, September-October 2005, pp. 22-25

[508] **Wijk, Rob de:** *The Limits of Military Power,* The Washington Quarterly, Winter 2002, pp. 75-92

[509] **Wijninga, Peter W. W. (Col.) and Szafranski, Richard:** *Beyond Utility Targeting, Toward Axiological Air Operations,* Aerospace Power Journal, Winter 2000, pp. 45-58

[510] **Wilcox, Greg and Wilson, Gary I.:** *Military Response to Fourth Generation Warfare in Afghanistan,* Internet, accessed 23. 09. 2002, available at www.emergency.com/2002/4gw5may02.htm

[511] **Wildavsky, Aaron:** *If Planning is Everything, Maybe it's Nothing,* Policy Science, Volume 4, 1973, pp. 127-153

[512] **Williamson, Peter J.:** *Strategy as Options on the Future,* MIT Sloan Management Review, Spring 1999, pp. 117-126

[513] **Wilson, G. I. (Col.) and Sullivan, John P. (Sgt.) and Kempfer, Hal (Lt. Col.):** *Fourth Generation Warfare, It's Here, And We Need New Intelligence-Gathering Techniques For Dealing With It*, Armed Forces Journal, International, October 2002, pp. 56-62

[514] **Wojtysiak, Martin (Lt. Col.):** *Another View of the Myths of the Gulf War,* Aerospace Power Journal, Internet, accessed 17. 09. 2004, available at www.airpower.maxwell.af.mil/airchronicles/apj/apj01/fal01/wojtysiak.htm

[515] **Wright, Sewall:** *Surfaces of Selective Value Revisited,* Notes and Comments, The American Naturalist, Volume 131, Number 1, January 1988, pp. 115-123

[516] **Wright, Sewall:** *The Roles of Mutation, Inbreeding, Crossbreeding and Selection in Evolution,* Proceedings of the Sixth International Congress of Genetics, 1932, pp. 356-366

[517] **Yehoshafat Harbaki:** *Basic Factors in the Arab Collapse During the Six-Day War*, Orbis, Volume 11, Number 3, Fall 1967, pp. 677-691

[518] **Zinni, Anthony C.:** *A Commander Reflects, What will be the operations of the future?* Proceedings, July 2000, pp. 34-36

MISCELLANEOUS

[519] *A Defining Moment in Marine Corps History*, Interview with Gen. Charles C. Krulak, Internet, accessed 15. 08. 2005, available at www.navyleague.org/seapower/krulak_interview.htm

[520] *A Dialogue on Analyzing Effects Based Operations (EBO),* led by Dr. Jacqueline Henningsen, SES, MORS Fellow of the Society, Director Air Force Studies & Analyses Agency, Internet, accessed 31. 03. 2003, available at www.mors.org/publications/phalanx/mar02/Lead2.htm

[521] **Abdoullaev, Azamat Sh.:** *The Ultimate of Reality: Reversible Causality,* Internet, accessed 16. 11. 2006 available at www.bu.edu/wcp/Papers/Meta/MetaAbdo.htm

[522] *Address to a Joint Session of Congress and the American People,* United States Capitol, Washington D. C., Internet, accessed 03. 08. 2005, available at www.whitehouse.gov/news/releases/2001/09/20010920-8.html

[523] *Air Force Operations Concept Aims at Success, Not Destruction, "Effects-based operations" a new but ancient military concept,* U.S. Department of State, International Information Programs, Issues in Focus, Interview with Maj. Gen. Deptula, 21 March 2003, Internet, accessed 06. 10. 2004, available at www.globalsecurity.org/wmd/library/news/iraq/2003/iraq-030321-usia14.htm

[524] **Baker, James A. III. and Hamilton, Lee H. et. al.:** *The Iraq Study Group Report,* United States Institute of Peace, 6 December 2006

[525] **Baranger, Michel:** *Chaos, Complexity, and Entropy, A physics talk for non-physicists*, Internet, accessed 24. 11. 2005, available at http://necsi.org/projects/baranger/cce.pdf

[526] **Barnes, Marvin:** *Effects-based concepts face test in Turkey*, ACT Operational Experimentation, 14 February 2006, Internet, accessed 21. 02. 2006, available at www.act.nato.int/multimedia/articles/2006/060214mne4.html

[527] **Beckerman, Linda P. Dr.:** *The Non-Linear Dynamics of War,* Science and Application Corporation, 1999, Internet, accessed 04. 07. 2003, available at www.belisarius.com/modern_business_strategy/beckerman/non_linear.htm

[528] **Boyd, John:** *Destruction and Creation,* September 3, 1976, Internet, accessed 22. 03. 2005, available at www.belisarius.com/modern_business_strategy/boyd/destruction/destruction_and_creation.htm

[529] **Boyd, John:** *Organic Design for Command and Control*, May 1987, Internet, accessed 26 May 2005, available at www.d-n-i.net/boyd/pdf/c&c.pdf

[530] **Boyd, John:** *Patterns of Conflict,* December 1986, Internet, accessed 22. 03. 2005, available at www.d-n-i.net/boyd/pdf/poc.pdf

[531] **Cebrowski, Arthur:** *Planning a Revolution: Mapping the Pentagon's Transformation,* Lecture presented to the Heritage Foundation on 13 May 2003, Internet, accessed 18. 05. 2005, available at www.heritage.org/Research/NationalSecurity/wm292.cfm

[532] **Conetta, Carl:** *Catastrophic Interdiction: Air Power and the Collapse of the Iraqi Field Army in the 2003 War,* Internet, accessed 07. 03. 2005, available at www.comw.org/pda/fulltext/0309bm30.pdf

[533] **Cordesman, Anthony H. and Burke, Arleigh A.***: Understanding the New "Effects-based" Air War in Iraq,* Center for Strategic and International Studies, 15 March 2003, p. 3, Internet, accessed on 31. 03. 2003, available at www.csis.org/burke/mb/iraq_airwar.pdf

[534] **Crowder, Gary L. (Col.):** *Effects Based Operations Briefing*, United States Department of Defense, News Transcript, 19 March 2003, Internet, accessed 27. 03. 2003, available at www.defenselink.mil/news/Mar2003/t03202003_t0319effects.html

[535] **Gallagher, Mark A. (Lt. Col.) and Snodgrass, Anthony W. (Capt.) and Ehlers, Greg (Capt.):** *Input-Output Modelling for Effects Based Operations,* Draft, Internet, accessed 15. 05. 2004, available at www.mors.org/meetings/ebo/ebo_reads/Gallagher_Snodgrass_Ehlers.pdf

[536] **Gartska, John J.:** *Network Centric Warfare: An Overview of Emerging Theory*, Joint Staff Directorate for C4 Systems, Internet, accessed 30. 05. 2006, available at http://www.mors.org/publications/phalanx/dec00/feature.htm

[537] **Hamilton, Booz A. and McLean, Virginia:** *Analyzing Effects-Based Operations*, Workshop Report 29-31 January2002, MORS, 2 January 2003, Internet, accessed 24. 12. 2005, available at http://www.mors.org/publications/reports/EBO_Report.pdf

[538] **Hoffmann, Bruce:** *Insurgency and Counterinsurgency in Iraq,* RAND National Security Research Division, June 2004

[539] **Hordijk, Wim and Kauffman, Stuart A.:** *Correlation Analysis of Coupled Fitness Landscapes,* Internet, accessed 12. 12. 2006, available at www.lirmm.fr/mab/IMG/pdf/HK-COMPLEX-05.pdf

[540] **Hughes, Robin**: *Interview, Lieutenant General Moshe Ya'alon, Israel Defence Force Chief of Staff,* Jane's Defence Weekly, 17 November 2004, p. 34

[541] **Huval, Joel:** *Exercise Allied Reach 2005 Concludes, SACT introduces Effects-Based Approach to operations during exercise in Norway*, ACT Public Information Office, 15 February 2005, Internet, accessed 21. 02. 2006, available at www.act.nato.int/multimedia/articles/2005/021505jwcar05.htm

[542] *Iraqi Insurgency Groups,* Internet, accessed 26. 01. 2007, available at www.globalsecurity.org/military/ops/iraq_insurgency.htm

[543] *Iraq Reconstruction – Introduction,* Internet, accessed 26. 01. 2007, available at www.globalsecurity.org/military/ops/iraq_recon_intro.htm

[544] **Lynch, Hugh:** *The Changing Character of Warfare*, Internet, accessed 22. 08. 2005 available at www.nwc.navy.mil/srd/Documents/Changing%20Character%20report.htm

[545] **Markides, Costas:** *Best Practice, Strategy in Turbulent Times,* Internet, accessed 16. 11. 2006, available at www.tiberius.ro/enter/BestPractice/4BestPractice.pdf

[546] **McCrabb, Maris "Buster" Dr. and Caroli Joseph A.:** *Behavioral Modeling and Wargaming for Effects-Based Operations,* Internet, accessed 14. 05. 2003, available at www.mors.org/meetings/ebo/ebo_reads/McCrabb_Caroli.pdf

[547] **McCrabb, Maris "Buster" Dr.***: Concept of Operations For Effects-Based Operations*, Draft, 2002a, Internet, accessed 03. 03. 2003, available at www.eps.gov/EPSdata/USAF/Synopses/1142/Reference-Number-PRDA-00-06-IKFPA/LatestEBOCONOPS.doc

[548] **McCrabb, Maris "Buster" Dr.:** *Explaining "Effects": A Theory for an Effects-Based Approach To Planning, Executing and Assessing Operations,* Version 2.0, 07. 08. 2001, Internet, accessed 08. 03. 2005, available at www.dtic.mil/jointvision/ideas_concepts/ebo.doc

[549] **McCrabb, Maris "Buster" Dr.:** *Limitations to an Effects-Based Approach to Planning, Executing or Assessing Military Operations*, received via e-mail from author on 12. 11. 2006

[550] **McCrabb, Maris "Buster" Dr.:** *Uncertainty, Expeditionary Air Force and Effects-Based Operations,* Air Force Research Laboratory, 2002b, Internet, accessed 23. 04. 2003, available at www.eps.gov/EPSdata/USAF/Synopses/1142/Reference-Number-PRDA-00-06-IKFPA/ uncertaintyandoperationalart.doc

[551] **McCullagh, Behan C.:** *Natural Necessity, Objective Chances and Causal Powers*, Internet, accessed 16. 11. 2006 available at www.bu.edu/wcp/Papers/Meta/ MetaMcCu.htm

[552] **Moseley, Alexander:** *A Philosophy of War,* Internet, accessed 25. 01. 2007, available at www.lewrockwell.com/orig3/moseley1.html

[553] **NATO Speeches:** *Press Briefing by Adm. Giambastiani SAC ACT on 12. 10. 2003*, Internet, accessed 21. 02. 2006, available at www.nato.int/docu/ speech/2003/s031112b.htm

[554] *Operation Iraqi Freedom,* Internet, accessed 26. 01. 2007, available at www.globalsecurity.org/military/ops/iraqi_freedom.htm;

[555] *Prague Summit Declaration*, NATO Press Release 127, 21 November 2002, Internet, accessed 12. 04. 2004, available at www.nato.int/docu/pr/2002/p-127e.htm

[556] **Ralston, Joseph:** *Keeping NATO's Military Edge Intact in the 21st Century,* Luncheon Address, given At the NATO/GMFUS Conference, Brussels, 3 October 2002, Internet, accessed 15. 12. 2004, available at http://www.nato.int/docu/speech/2002/s021003d.htm

[557] **Ramsey, Marshall:** *GA Optimizer*, Artificial Intelligence Lab, The University of Arizona, Internet, accessed 21. 11. 2006, available at http://ai.bpa.arizona.edu/ ~mramsey/ga.html

[558] *Remarks by the President of the United States , George W. Bush to the Atlantic Student Summit*, 20 November 2002, Internet, accessed 20. 11. 2004, available at www.nato.int./docu/speech/2002/s021120f.htm

[559] **Sidran, Ezra D.:** *A Calculated Strategy: Readings directed towards the creation of a strategic artificial intelligence,* Readings for Research, Spring 2004, Internet, accessed 10. 11. 2005, available at www.cs.uiowa.edu/~dsidran/ ReadingsForResearch2.pdf

[560] **Snowden D.:** *Being efficient does not always mean being effective, a new perspective on cultural issues in organisations*, Internet, accessed 21. 11. 2006, available at www.cognitive-edge.com/ceresources/articles/42_new_perspective_on_culture_final .pdf

[561] Speech by Chief of the Army Lt. General P. F. Leahy at Conference held at the National Convention Centre in Canberra on 22 September 2005, Internet, accessed on 29. 04. 2008, available at http://www.defence.gov.au/army/pubs/CAspeeches/20050922_1.pdf

[562] *The Genotype/Phenotype Distinction*, Stanford Encyclopedia of Philosophy, Internet, accessed 21. 09. 2006, available at http://plato.stanford.edu/entries/genotype-phenotype

[563] *The Transformation of NATO*, Opening speech by President of the Czech Republic, Vaclav Havel at the Conference organised by Host Committee and the Aspen Institute of Berlin, 20 November 2002, Internet, accessed 16. 09. 2004, available at www.nato.int./docu/speech/2002/s021120c.htm

[564] *The United Kingdom Delegation to NATO*, Prague Capabilities Commitment, 11 July 2003, Internet, accessed 20. 08. 2004, available at www.nato.int/uk/docu/capa2.htm

[565] *The United States Strategic Bombing Survey,* Summary Report European War, 30 September, 1945, Internet, accessed 25. 10. 2005, available at www.anesi.com/ussbs02.htm#c

[566] **The White House:** *President Sworn-In to Second Term,* Internet, accessed 27. 01. 2005, available at www.whitehouse.gov/news/releases/2005/01/20050120-1.html

[567] *U.S. Casualties in Iraq,* Internet, accessed 26. 01. 2007, available at www.globalsecurity.org/military/ops/iraq_casualties.htm

[568] **Van Riper, Paul K.:** *Planning for and Applying Military Force: An Examination of Terms,* Strategic Studies Institute, March 2006

[569] **Van Riper, Paul K.:** *Precision and Clarity in Military Language*, received via e-mail from the author on 05. 09. 2006

[570] **Wagenhals, Lee W. and Levis, Alexander H.:** *Effects based course of action analysis in support of war games*, Internet, accessed 18. 03. 2003, available at www.mors.org/meetings/ebo/ebo-reads/Wagenhals_Lewis.pdf

[571] **Wikipedia:** *Six-Day War*, Internet, accessed 07. 03. 2006, available at http://en.wikipedia.org/wiki/1967_war

[572] **Wolfe, Frank:** *Air Force Officials To Emphasize Effects-Based Operations in QDR,* Defense Daily, 18 January 2001, Internet, accessed 31. 03. 2003, available at www.dean.usma.edu/socs/ECON/ens/articles/QDR_USAF_18Jan01.htm

About the Author

Lieutenant-Colonel Zoltán Jobbágy is an infantry officer of the Hungarian Defence Forces. After graduating from the Kossuth Lajos Military College in Szentendre in 1990 he was assigned to the 32nd Guard Regiment and served as a platoon commander till 1992.

Following a successful application to the University of the Bundeswehr he studied Education with a focus on Personnel Management and Adult Education in 1992-1997 in Hamburg, Germany.

After returning from abroad he was appointed to the Ministry of Defence where he first worked in the NATO Department and then for two years as assistant to the Deputy State Secretary for Human Policy. He also attained a master's degree in International Relations and Diplomacy from the Budapest Institute of Graduate International Studies at the University of Economic Science in 1997-2000 in Budapest, Hungary.

He served as officer in charge of the 1st Hungarian Company working with the United Nations in Cyprus in 2000-2001. After returning to Hungary he worked until 2003 as senior analysis and planning officer within the Human Policy Department, Ministry of Defence.

From 2003 till 2007 he was a researcher at TNO Defence, Security and Safety and associated with the Clingendael Institute in The Hague, the Netherlands. In his recent assignment he works as deputy head of Human Strategy Division, Planning and Co-ordination Department, Ministry of Defence, Hungary.

His tours of duty abroad also included an assignment in 2008-2009 in Sarajevo, Bosnia and Hercegovina, where he worked as NATO advisor for personnel management.

Lieutenant-Colonel Jobbágy is happily married to the former Andrea Székely and has two sons, Kristóf and András.