HUMAN SYSTEMS APPROACH TO A MORE EFFECTIVE APPLICATION OF AIR POWER

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Since the advent of the heavier than air flight in 1903, theorists have posited numerous schemes to best exploit the inherent ability of aircraft to rise above the fray of the battlefield and go straight to the heart of an enemy nation. The seeds sown by these theories have steadily evolved throughout the 20th century. Along the way, the theories have been fashioned by the lessons of war, remarkable advances in technology, and the visionary concepts of a few, select airmen. Two modern-day theorists, Col John Boyd and Col John Warden, have significantly contributed to this evolutionary process. While Boyd does not offer an air power theory *per se*, his thoughts on conflict have significant implications for the employment of air power at all levels of psychological war. In contrast, Warden has developed air power theory, but primarily focusses on the strategic application of the air weapon.

The question for air power theorists must be, "Where should air power be focussed in order to contribute to effects?" This paper argues that the existing disparate air power theories are part of a continuum that can be integrated using a **human systems model** [1]to provide a range of options for influencing an adversary's means and will. The paper elucidates that the human systems model offers an explicitly holistic view of the adversary as a

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1. Sqn Ldr A H Killey, RAF, "Air Power Compendium Beyond Warden's Rings? A Human Systems Approach to the More Effective Application of Air Power".

The context is the key question for air power theorists, "Where should air power be focussed in order to contribute to joint effects?" Seemingly competing theories have emerged that variously advocate focussing the role of air power to influence the adversary's physical means or moral will.

system, and provides a conceptual framework for understanding the cascade of direct and indirect physical and psychological effects. It postulates that air power is most effective when used to influence an adversary's will, rather than his means, but its use must always be tailored to the properties of the adversary and the political objectives.

Air power transformed the conduct of war in the 20th century[2]; the end of the Cold War, the phenomenon of globalisation and trans-national terror-based organisations aka Islamic State in Syria (ISIS) are transforming global security in the 21st century.

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>
> – Clausewitz

The context is the key question for air power theorists, "Where should air power be focussed in order to contribute to joint effects?" Seemingly competing theories have emerged that variously advocate focussing the role of air power to influence the adversary's physical means or moral will. Within these arguments run sub-currents of strategic thought: should air power concentrate on influencing the means at the strategic or operational level? When influencing an adversary's will, should air power aim to paralyse his ability to decide what to do, or to change the gains the adversary hopes to make from choosing a particular course of action? It must be brought out here that these are two striking examples in the same air force which has used the same strategy for two engagements, separated by time. First, refer to Gulf War 1 where strategic paralysis was achieved in four days using Warden's model.

2. David S Fadok (USAF), Directorate of Conceptual Studies Air HQ VB Study Material.

However, the same was not applicable to the ISIS, because a higher bombing level caused an increase in the motivation levels to resist.

The purpose of this paper is to argue that these theoretical perspectives are part of a continuum that can be integrated to provide a range of options for influencing an adversary to comply with one's will. The decision as to which portion of the continuum is to be used, must be based on an understanding of the adversary, the objectives of both sides, and on what must happen to the adversary to achieve political objectives.[3] First, each theoretical approach is briefly reviewed, highlighting its strengths and weaknesses, and employment in recent military operations.

Warden's theory of strategic attack is a form-oriented attack and aims at physical paralysis. It advocates parallel inside-out attacks against the enemy's five strategic rings.

Boyd's thoughts on strategic paralysis are process oriented and aim for psychological incapacitation. He speaks of folding an opponent back upon itself by operating inside the Observe, Orient, Decide, Act (OODA) cycle. Boyd's aim is to cause psychological incapacitation by a decision dilemma. Warden's theory of strategic attack is a form-oriented attack and aims at physical paralysis. It advocates parallel inside-out attacks against the enemy's five strategic rings. Next, a model based upon the characteristics of human systems is proposed as an integrating framework for the different strands.

DESCRIPTION OF HUMAN SYSTEMS: THE HUMAN SYSTEMS OF THEORY

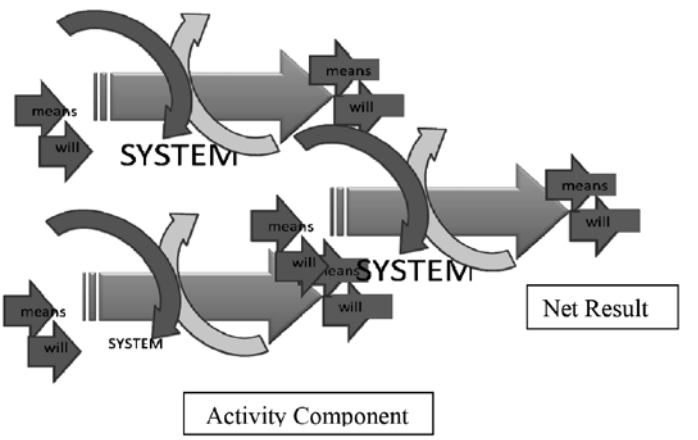
Human organisations adopt a course of action as a result of **their means** and **will** to do so. Means and will are the collective outputs of the systems that make up a human organisation, be it a nation-state, a trans-national corporation, or a terrorist group. A system is a collection of elements connected together to achieve a common purpose.[4] Although, there are many methods to classify systems, this paper adopts the definition used

3. *Air Force Manual 1-1: Basic Aerospace Doctrine of the United States Air Force*, vol II (Washington DC: Department of the Air Force).
4. Cdr Lawrence N Ash, *Fighting for Network-Centric Warfare*, Proceedings (August 2000), pp. 74-76; Thomas PM Barnett, *The Seven Deadly Sins of Network-Centric Warfare*, Proceedings (January 1999), pp. 36-39.

by Warden's five-rings model as it permits a common frame of reference for analysis. Human systems – systems in which humans form an integral element – possess a high level of internal linkage, the ability to self-regulate, adapt and respond unpredictably. All human systems are made up of two components: an activity component that produces goods, services, organisations; and information, overlain by a cognitive component that decides how the activity component behaves (see Fig 2 below).

Fig 1

Fig 2

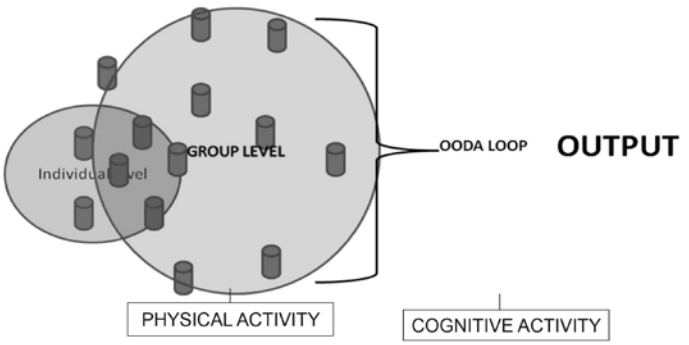


Activity Component

This is made up of collections of individuals and groups, connected by inter-personal relationships at both individual and group levels. These individuals and groups make decisions on the basis of what they observe about the output of activities, analyse what they perceive, make judgments about the situation, decide how to respond or act, and then control the activities

to be performed in a required manner. The processes used to observe, perceive, judge and decide are described in Boyd's OODA loop model. It is a combination of the activity component producing outputs and a cognitive component making decisions that gives human systems the properties of self-regulation, adaptation and unpredictable responsiveness.

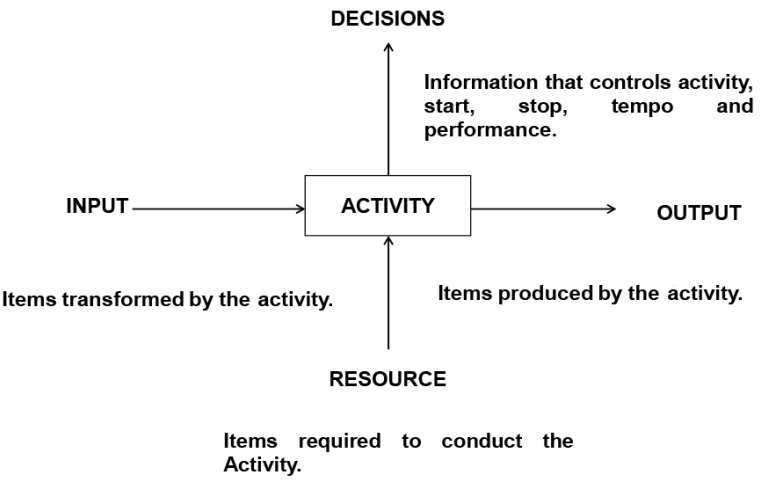
Fig 3



The Cognitive Component

The activities in a human system are controlled and coordinated by the cognitive component.

Fig 4

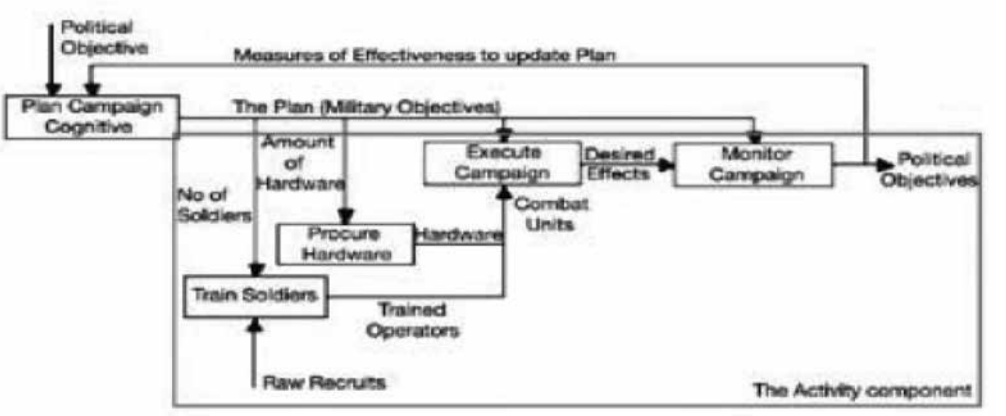


ACTIVITY, INPUTS, OUTPUTS, RESOURCES AND DECISIONS

The Activity Component

The activity component of a human system [5]is made up of a collection of linked physical activities that transform inputs into desired outputs, in accordance with decisions, using resources (see Fig 3). One activity's outputs are another activity's inputs or resources[6]. Inputs can be tangible items such as raw materials for a manufacturing process, or intangibles such as information input into a computer system. Outputs can be tangible, such as manufactured products or services, or intangible items such as concepts or information. Resources are required for the activity to take place, but are not transformed into the output; for example, the people required to carry out procedures; production machinery, infrastructure, i.e. factories and offices in which to conduct work; power, heating and lighting. The information controlling when activities start and stop, the rate at which they transform inputs into outputs, the use of resources, the standards to work to, and the targets to reach, are all derived from decisions made by the cognitive component.

Fig 5: The Elements and Links in the Activity Component



5. That is to say that, working together, the elements produce something greater than if the activities worked in isolation. See Wilson (1990), pp.24, 40, and Warden (1995).
6. Ibid.

Activities provide outputs that are used by other activities, whether as inputs or resources, and these link activities together and make them dependant upon each other. For example, an activity that outputs petroleum products is producing an input for a military system, and an activity that outputs electricity is providing a resource for all activities that require electrical power. This dependency of activities upon outputs is as important as the transformation carried out by the activity itself. It is the combination of individual outputs that defines the system's collective output, and human systems need a minimum degree of connectivity for the output to be produced. For example, national military power is the sum of all the activities that design, manufacture, transport and support combat equipment, and those activities that recruit, train and administer the personnel. As more and more activities stop delivering their outputs, the system reaches a point at which it cannot deliver military power. Human organisation systems are not only dependent upon the connectivity of their internal activities; they are also dependent upon outputs from the internal activities of the other systems, producing a network of interdependence (see Fig 6). In this respect, the human systems model differs substantially from Warden's hierarchical model. Like Warden's model, each system can be continuously broken down in more and more detail to provide greater definition of the connectivity between activities. The relative dependence between each system is contingent on many factors, including the size, purpose and culture of the organisation.

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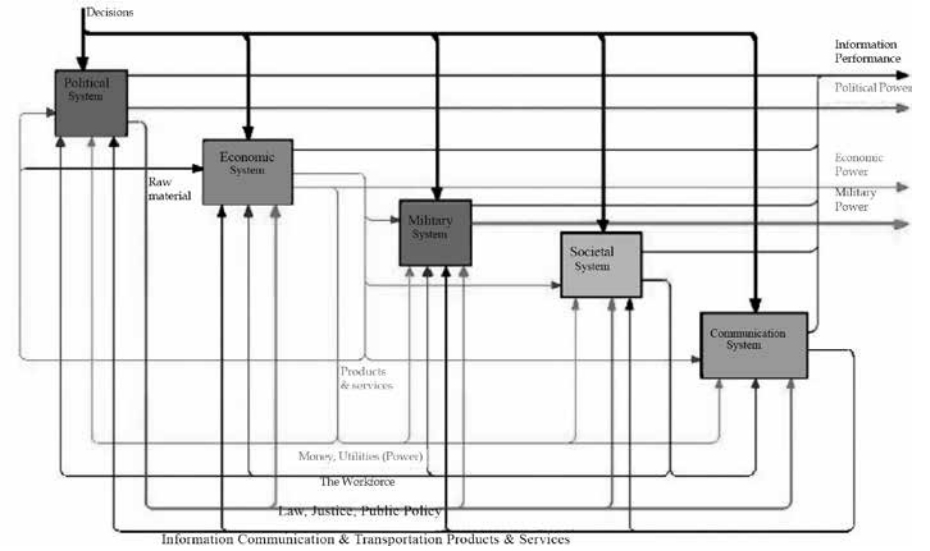
Fig 6



The interdependence of systems in the human system. and sub-systems will lead to a detailed understanding of how the systems deliver outputs, and will identify which activities are critical for the production of a given output.

CENTRES OF GRAVITY (CofG)

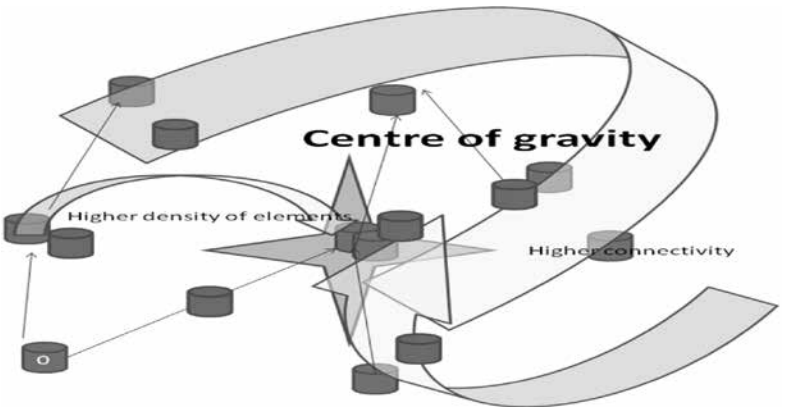
Within each system, there will be a region where the number of elements and density of links, both between the elements within the system and between the cognitive and activity components, is relatively high. This is the region of the system that makes the most significant contribution to the system's collective output. An adversary's Centre of Gravity (CofG) is a region where sufficient connectivity exists among the elements to enable the system to deliver an output that is critical to providing the adversary with the means and will to undertake a course of action, at a specific time (a critical capability).[7]

These critical outputs are not necessarily the adversary's greatest strength or weakness and unless the adversary has sufficient connectivity, he may not necessarily have a CofG. As each system may have a region of

7. For a detailed analysis of critical capabilities, requirements and vulnerabilities, see J Strange, "Centers of Gravity and Critical Vulnerabilities," *Perspective on War-Fighting*, no. 4 (US Marine War College).

high connectivity, the adversary may have more than one CofG, as is the case with Warden's 5-ring model. Where sufficient connectivity does exist, the human systems model can be used to identify the elements and links that form the CofG. This concept of a CofG mirrors Clausewitz's contention that a CofG is the "hub of all movement and power".

Fig 7



System Self-Regulation and Adaptation: Human systems are constantly subjected to influence from their external environment and they possess the ability to respond to it by making decisions that modify the outputs that activities deliver. The rate at which activities produce outputs depends not only on decisions but also on the availability of inputs and resources. Consequently, changes in an activity's performance may propagate along the output links and affect the performance of activities that use that output. The cognitive component coordinates all the changes necessary to respond, or adapt, to environmental influences. Performance information from activities is used by the cognitive component to decide how to adjust activities in the system. These adjustments may work to minimise the impacts of external influences, or to adapt the system to its new environment if this leads to survival or a more effective method of achieving the common goal. For example, military systems are able to react to the consumption of assets by resupplying themselves in order to maintain a relatively constant level of combat potential. Human systems have too many elements and links to

exist in a steady state of activity and are inherently dynamically unstable, as influences and decisions work their way through the output links in the system. The ability to cope with, or adapt to, the environment means that the same influence applied to the same point of the system at a different time may result in a very different outcome because the system has adapted. This means that the effects of external influences can be time-sensitive.[8]

However, a human system's ability to cope with, or adapt to, the external environment is constrained in two ways. Firstly, the range of output that an activity can deliver is limited by the quantity of input or resource available. Secondly, the changes brought about by an external influence can exceed the cognitive component's ability to perceive, recognise, control and coordinate changes to, performance across many activities. The role of perception and judgment in the cognitive domain and the inherent dynamic instability of human systems mean that they often display non-linear responses to external influences: seemingly powerful influences may have a limited effect whilst small ones may have a disproportionately large effect Furthermore, external influence may have little effect until some 'critical mass' is reached or have no effect unless some other condition is present. For example, a fielded force in combat can continue to fight whilst taking casualties, until a critical level of degradation is reached, at which point the force collapses.

APPLICATION OF HUMAN SYSTEMS TO AIR WARFARE

This is the most dynamic form of warfare in terms of time, changes to the ground situation and the effect of a single weapon delivered accurately. The ability of an organisation to behave in a certain manner is a product of its physical means and moral will to act. Means are the collective output of the activity component and will is the collective output of the cognitive component. Shaping an organisation's behaviour requires exerting influence on its means, will, or both. The application of the human systems model to warfare identifies three strategic approaches for exerting influence on an adversary: destruction of the system's elements, disruption of the

8. Andrew Ilachinski, *Land Warfare and Complexity*, Part II. Assessment of the Applicability of Non-Linear Dynamic and Complex Systems Theory to the Study of Land Warfare (Alexandria VA, Centre for Naval Analysis, July 1996), pp.139-140.

system's connectivity, and exploitation of the system's control mechanism. These three strategic approaches are assessed in the light of three recent operations, Desert Storm, Deliberate Force and Allied Force.

SYSTEM DESTRUCTION STRATEGIES

System destruction strategies aim to destroy the elements of an adversary's system with the objective of denying the adversary the means to pursue a course of action. Moral will is an abstract concept and cannot be targeted directly by physical means. Consequently, the focus of system destruction strategies is on the system's physical elements, particularly the fielded forces, although all systems have physical elements that, theoretically, could be destroyed.

In Operation Desert Storm, the fielded forces provided Iraq with the means to occupy Kuwait. Up to 12,000 Iraqi troops were killed, the combat effectiveness of many units was reduced by 100 percent and the Iraqi Army in Kuwait collapsed. System destruction strategies aim to destroy the elements of an adversary's system with the objective of denying the adversary the means to pursue a course of action. Moral will is an abstract concept and cannot be targeted directly by physical means. Although the coalition achieved air superiority within 48 hours of the start of the operation, it still sought the physical destruction of the Iraqi Air Force. Despite destroying runways, taxiways and hardened aircraft shelters, nearly 45 per cent of Iraq's aircraft emerged from the war unscathed. However, it took 23,430 sorties, approximately two-thirds of the coalition's air power, to achieve this defeat, and more Iraqi soldiers deserted than were killed The key political objectives of the complete destruction of the Republican Guard and Iraq's nuclear, biological, and chemical weapons programmes were not achieved despite the coalition's overwhelming military power. The Republican Guard suffered about 24 percent attrition, but remained sufficiently capable to withdraw from Iraq and, subsequently, suppress the Kurdish and Shiite rebellions. Only 25 percent of Iraq's nuclear weapon programme sites were attacked and the efforts to destroy Scud missile systems and chemical and

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biological weapons were disappointing.[9]

One of the strategies implemented in Desert Storm was the destruction of a small number of political targets in the hope of decapitating the regime, leading to regime change or decision-making paralysis. However, political targets proved difficult to locate and strike effectively. Decapitation may have been unachievable and undesirable as there was no evidence that the death of Saddam Hussein would have resulted in the reins of power being taken up by someone with the ability or desire to unconditionally withdraw the Iraqi Army from Kuwait.[10] Saddam Hussein's regime was not decapitated and remained sufficiently in command of its forces in Kuwait to coordinate the orderly withdrawal of the Republican Guard from Kuwait.[11]Targeting the adversary's systems for wholesale destruction is a strategy that has not been employed since Operation Rolling Thunder in Vietnam. The destruction of organic essentials and infrastructure to debilitate the fielded forces was a central tenet of the strategic air offensives against Germany and Japan during World War II. However, as this demonstrated, these systems are difficult to destroy entirely, requiring precision bombing, and having considerable capacity to absorb punishment, and regenerating or finding alternative sources for inputs and resources and rerouting outputs.

The destruction of the adversary's population, as genocide or ethnic cleansing, involves mass murder, systematic terrorisation and enforced relocation of an ethnic group, and has been a feature of recent intra-state conflicts. Up to one million Muslims were expelled from their homes in

9. Despite claims that Iraq's nuclear, biological, chemical weapons programmes had been destroyed by six weeks of bombing, the United Nations team soon discovered that more than 100 Scud missiles had survived, as had missile production equipment, and at least 19 mobile launchers, and components from new, two-stage missiles. In addition, 70 tons of nerve agent and 400 tons of mustard gas also escaped destruction. Atkinson (1993), p.496.
10. Watts et al, (1993), p.27.
11. Eduard Mark, *Aerial Interdiction In Three Wars* (Washington DC, USA: Centre for Air Force History, 1994), p.224; Pollack (1996), pp.548-555.

Serbian-occupied areas in Bosnia between 1992 and 1994. In Kosovo, Serbian security forces killed up to 10,000 and created an estimated quarter of a million refugees. However, as the perpetrators of such crimes against humanity have discovered, not it is only extremely difficult and morally reprehensible to destroy a population entirely, it is illegal under international law.

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Despite the perceived relative ease of finding targets for physical destruction as compared to targeting an adversary's will, the level of force and effort required means that physical destruction of a system may not be the cheapest, quickest, or even legal method of achieving political ends. Decapitation may remove the only means of establishing a dialogue with the adversary. Attempts to destroy command and control have not been effective and the destruction of lines of communication, particularly bridges, can impede the movement and resupply of friendly forces. The destruction of organic essential systems and infrastructure has some significant disadvantages for peace in the state afterwards. For the resulting organisation to rebuild itself post conflict, those elements of the system that have been destroyed may need to be rebuilt rapidly. In addition, the mass casualties and extensive collateral damage that such economic warfare produces is becoming increasingly politically unacceptable to modern Western liberal democracies.

The horrific loss of life and cost in national treasure that fighting entails, illustrated by two World Wars, has always stimulated the search for more effective ways of influencing the adversary's means and will, by disrupting the output from these systems rather than attempting a systems destruction by hard fighting.[12]

12. Basil H., Liddell Hart, *Strategy* (London: Faber & Faber Ltd, reprint, New York: Penguin Books, 1991), p.21 (page references are to reprint edition).

SYSTEM DISRUPTION STRATEGIES

The connectivity between and within human systems is a vulnerability as well as the source of its collective outputs. An adversary's fielded forces are dependant upon outputs from the leadership, organic essentials, and infrastructure and population systems. System disruption strategies target a system's connectivity with the intention of reducing it below the level of minimum essential connectivity, not its destruction. At this point, the functioning of the system is degraded to such an extent it is no longer able to deliver its outputs and the adversary will be denied the use of his fielded forces. In all the case study operations, the disruption of the connectivity in the military Command and Control (C2) activities aimed to deny the military system any enhanced combat effectiveness through integration. This is best illustrated by the efforts to deny the air defence output provided by an Integrated Air Defence System (IADS) in order to gain access to the rest of the military and other systems. In all cases, the IADS was disrupted by physical strikes on communication nodes, disruption of electrical power, and destruction of the early warning radar sites, surface-to-air missiles guidance radars, and missile launchers, and sector operations centres.

In all cases, the IADS was driven into systemic failure in the first 48 hours, successfully forcing the adversary's air defences to operate autonomously, if at all, and permitting access to all the adversary's systems.[13]

In all three case studies, one of the strategies chosen was to target the infrastructure system to disrupt (interdict) resupply to the fielded forces. Military depots, storage facilities, supply infrastructure and transportation systems were attacked. During Desert Storm, the coalition substantially degraded supply capacities. In Deliberate Force, this disruption strategy so successfully denied the Bosnian Serbs their essential war stocks that they seized UN Protection Force personnel as hostages and chained them to storage buildings in an effort to halt the bombing. However, "anybody that does a campaign against transportation systems [had] better beware! It looks deceivingly easy. It is a tough nut to crack." The Iraqis proved ingenious at using pontoon bridges, ferries, causeways, alternate routes, and underwater

13. In each operation, low level air operations were still prevented by the proliferation of hand-held surface-to-air missiles and anti-aircraft artillery.

bridges to keep sufficient supplies flowing into the theatre. After achieving their initial objectives in Kuwait, they adopted a static posture, using stockpiled ammunition and diesel fuel sufficient for weeks or even months of combat. There were some frontline units that experienced extreme shortages of food and water but overall, the Iraqi Army was not defeated due to lack of supplies.

During Operations Desert Storm and Allied Force, oil refining, distribution and storage facilities, and military production facilities were all struck by air power. The objective in targeting selected organic essentials activities was to cripple specific outputs, military material and refined petroleum products.

During Desert Storm, the coalition reduced oil refining capability by 93 percent and 20 percent of petroleum products held at refineries and major depots were destroyed. During Operation Allied Force, 50 percent of Serbia's war industries were largely destroyed. Oil refineries were targeted and petroleum reserves dwindled, dual-use vehicle manufacturing plants and chemical industry plants were struck to deny the Serbian military resupply and reinforcements. The effectiveness of disrupting organic essentials is dependent upon the resupply requirements of the fielded forces; for example, the Iraqi Army had limited resupply requirements, so disruption of organic essentials did not affect the fielded forces in any significant manner.

An additional purpose of targeting electricity generation plants during Operations Desert Storm and Allied Force was to disrupt power to the communication and information system that linked decision-makers and military commanders. The Iraqi electrical supply was reduced by 88 percent. As with the attempt to destroy the C2 system in Desert Storm, the attempt to disrupt C2 was not effective in Allied Force, as Milosevic had sufficient control to withdraw the Serb forces from Kosovo, promptly and in good order

Disruption strategies can be differentiated by the choice of system to be influenced, and the depth to which the system is disrupted. Disruption can be achieved without applying the same level of force as to system destruction, and potentially exposes fewer personnel to risk. Its effectiveness in denying the adversary his means can be decisive, as the disruption of IADS in all three case studies shows. However, the effectiveness of the disruption of C2

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and resupply to the fielded forces is entirely contingent upon the character, posture and intent of the fielded forces. As such, the use of a system disruption strategy needs to be matched to the military context.

System disruption strategies have been described only in terms of achieving purely Clausewitzian physical effects. However, "Physical force does not win a war, mental force does not win a war. What does win a war is the highest combination of these forces acting as one force". Every activity in a human system is controlled by a cognitive component and all physical effects will inevitably have a psychological effect on the adversary's cognitive component. Therefore, system disruption strategies can initiate a cascade of physical effects that have psychological effects on the adversary's decision-making.

System exploitation strategies seek to exploit the linkage between the activity and cognitive components in one of two ways; either by influencing the cost-benefit calculus of the decision-making process so that the adversary chooses an acceptable course of action, or manipulating the system's limited self-control capability.

SYSTEM EXPLOITATION STRATEGIES COST/BENEFIT MANIPULATION

Within the cognitive component, decisions are based on the decision-maker's perception and judgment of the costs and benefits of a course of action. A rational actor will adopt a course of action that maximises the benefits and minimises the costs. [14] System exploitation strategies seek to use national power to influence the adversary's cost/benefit calculus, either by dissuasion or coercion. In human system terms, dissuasion strategies involve the use of military power

14. Allison et. al., *Essence of Decision Making: Explaining the Cuban Missile Crisis* (London: Harper Collins, UK, 1971), pp. 16-18, 143.

to block an adversary's course of action without actually imposing a cost on the adversary. The North Atlantic Treaty Organisation (NATO) operation in Bosnia prior to Deliberate Force was Deny Flight. This operation was intended to dissuade the Bosnian Serbs from attacking the Croats and Muslims simply by the physical presence of NATO forces between both sides of the conflict .Coercion is the employment of a system disruption strategy, but the primary aim is psychological effect, not physical influence. When the decision-makers are not rational, coercion may fail, as decisions are not made on the basis of cost/benefit analysis, but on some other basis. In these cases, it may be necessary to adopt the system destruction strategy, described earlier.

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Both Operations Deliberate Force and Allied Force were primarily aimed at influencing the adversary's cost/benefit calculus by increasing the costs of continued action by the adversary. In the case of Deliberate Force, the coercion was applied almost exclusively by inflicting pain upon the Bosnian Serb Army. In the case of Operation Allied Force, the coercion graduated from hurting the fielded force, to inflicting mild pain on the Serbian elite, to punishing Milosevic and his closest supporters. Operation Deliberate Force aimed to influence the Bosnian Serb leadership's will, using both military and political power. NATO specifically permitted sufficient connectivity between the decision-making leadership and the fielded forces so that the leadership had a complete and accurate picture of what was happening to its forces. This strategy was specifically aimed at influencing the adversary's will by exploiting the connectivity between cognitive and activity components, rather than specifically disrupting it. Air power disrupted C2 sufficiently to ensure that the Bosnian leadership was unable to respond militarily to NATO's action, whilst still remaining in contact with its commanders in the field. Political power (i.e. diplomacy), was interspersed with the use of military

force to spell out the political terms the Bosnian Serbs would have to meet. The interplay between air and political power was at its most powerful when NATO 'paused' the operation on September 1 to permit diplomatic efforts between the Bosnian Serbs and the UN and Ambassador Holbrook. When it became obvious that the Bosnian Serbs were not meeting the UN-NATO demands, Deliberate Force was resumed. Ambassador Holbrooke observed, "If the bombing had not resumed that day, the negotiations would have been very adversely affected".

The Bosnian Serb government received a complete and accurate picture of the damage to its fielded forces and the size of NATO's military power, as well as its determination to use it. Initially, the Bosnian Serb government discounted NATO's threat. NATO's efforts to destroy the Bosnian Serb Army's heavy weapons, by besieging Sarajevo, were frustrated by the practical difficulties of locating, identifying and striking small, well-concealed and dug-in targets. This reduced the credibility of the threat, as did the physical and moral support it received from the Serbian government. However, a decade of sanctions had taken its toll on the Serbians' morale and political cohesion and convinced Milosevic to withdraw his support to the Bosnian Serb government in order to preserve his own political power in Serbia This loss of alliance cohesion caused the Bosnian government to reassess its cost/benefit analysis of the situation, and, as the costs of its course of action rose, it was successfully coerced into agreeing to NATO's terms, despite having resisted them for so long.[15]

Operation Allied Force began as an attempt to coerce Milosevic by hurting his security forces in Kosovo. NATO's efforts to destroy the Serbian Army's heavy weapons in Kosovo simply drove them into hiding, making subsequent attacks largely ineffective. Milosevic was not coerced by the disruption of his fielded forces or the systems providing support to them, and the Serbians managed to sustain their ethnic cleansing action. NATO decided to exploit the links between the Serbian political and social systems. A decade of sanctions had caused a significant stagnation in the Serbian economy: per capita Gross Domestic Product (GDP) had roughly halved to £8,000 and unemployment was at about 50 percent. The electricity

15. Steven Burg and Paul Shoup, *The War in Bosnia- Herzegovina: Ethnic Conflict and International Intervention* (1999), pp.328-360.

grids were severely damaged, 85 percent of Serbians had limited electrical power, and the water supply to Belgrade was under threat. The business premises owned by Milosevic and his closest supporters were destroyed and income from smuggling activities was reduced, quite unintentionally, by the destruction of bridges. NATO's actions increasingly threatened to bankrupt the Serbian elite, who, in response, sent their families out of Yugoslavia and put considerable pressure on Milosevic to capitulate.

In Milosevic's cost/benefit calculus, the decision by NATO's leaders to forgo the threat of a ground invasion meant that NATO's threats were not credible. The mounting damage caused by the air campaign, NATO's increasingly convincing statement about a ground invasion and increasing internal political pressure, gradually raised the cost to Milosevic's position of power, of holding onto Kosovo. Additionally, his failure to destabilise neighbouring countries or split the alliance[16], signalled to Milosevic that the tactical tide was turning against him and his own defeat was inevitable. Milosevic decided that he did not value Serbian control of Kosovo above his own survival. As with Operation Deliberate Force, the support of Serbia's Russian ally played a key role in the outcome of Allied Force. Initially, Russia was a strong supporter of Milosevic, but as the conflict progressed, Russia grew increasingly willing to cooperate with the US in the pursuit of a diplomatic solution. Possibly, the final straw was Moscow's silence in response to the indictment of Milosevic for war crimes on May 25, 1999. This eliminated any remaining chance that Russia might change course and resume its support for him. Capitulation became his best course, both to minimise further damage to Serbia and its military and to secure his position in power while NATO and the UN were still willing to talk with him.

As all the adversary's systems have a cognitive component, they are all liable to psychological influence. During Desert Storm, some Iraqi power plant managers took their plants off-line in a preemptive move in order to preclude damage and the coalition specifically planned to convince the Iraqi population to rid them of the Ba'athist regime by disrupting the electrical

16. Ivo H Daalder, et. al. (2000), p.202; Judah (2000), p.271; Lambeth (2001), p.xiv; and Ivo H Daalder, "Hard Choices: National Security and the War on Terrorism," *Current History*, December 2002, pp. 409-413.

and telecommunications facilities. This was supposed to demonstrate to the people of Baghdad that the Iraqi president was powerless to counter the US air offensive. The planners wanted to "make [every Iraqi household] feel they were isolated. [we] didn't want [the Iraqi people] to know what was going on." There is no hard evidence that using air power to turn out the lights in Baghdad broke the population's will or affected the population's attitude toward Saddam and his regime in any significant manner

In Operations Desert Storm and Allied Force, considerable efforts were made to apply psychological pressure on the decision-making calculus of all individuals in the fielded forces. In addition to heavy bombing of ground formations, with substantial numbers of dumb bombs, to create fear, more overt psychological pressure was exerted through leaflet deliveries, and television and radio broadcasts. During Desert Storm, up to 100,000 troops, 30 percent of Iraqi soldiers, deserted. During Allied Force, troop desertion rates reached 300+ per day and an increasing numbers of Yugoslavs evaded reserve call-ups. Post World War I, strategists like Douhet and Mitchell had advocated bombing centres of population in the belief that the fear that this would cause would make the people force their governments to give in. However, the bombing of major cities in World Wars I and II failed to break the will of the people. Moreover, the deliberate targeting of non-combatants is illegal under international law, although this is a core strategy of terrorist organisations.

SYSTEMIC PARALYSIS

A system paralysis strategy aims to exploit the system's self-regulation capability by overwhelming it.[17] Boyd provides an excellent description of how this effect is achieved in his OODA loop model. In the context of the human system model, the "menacing environment" that Boyd desires is achieved by using air power to disrupt outputs. The disruption of an output will propagate to all downstream activities and indirectly affect the downstream activity through the input and resource dependencies. Indirect physical effects may also cascade upstream as those upstream activities are affected by the changes in the use of their outputs. More importantly, the

17. William Lind, "4th Generation Warfare and the Dangers of Being the Only Superpower: A Warning from Clausewitz", *Counterpunch*, March 8, 2003.

cognitive component will start to receive performance information about changes in outputs and will try to the match the pattern of changes to those learnt or experienced before. Based upon the degree of match, the cognitive component will make a judgement about what is happening and decide how to adjust outputs in response. "Rapid and repeated combinations of ambiguous, but threatening effects, and deceptive, but non-threatening ones" will reduce the accuracy of the match and lead to increasingly inappropriate responses. If the speed at which the cognitive component process information falls below the speed at which it receives it, decisions are more and more likely to be out of touch. Inappropriate controls will result in mismatches among inputs, outputs, controls and resources that the adversary must eliminate if decisions are to result in actions that enable him to adapt to such an environment. If the adversary cannot do this, his reactions become totally inappropriate to the situation and paralyse his ability to reorientate to a rapidly changing environment. The inevitable consequence of failure is chaotic behaviour in the activity component, and decision-making paralysis in the cognitive component that will result in defeat.

MODEL SUMMARY

Each case study operation used air power to prosecute one or more of the strategies described. In all cases, air power's kinetic effects were used, either just for physical effects, or to initiate a cascade of physical and psychological effects. Peace support operations appear in the conflict continuum, but were not specifically covered in the case studies. Despite the concentration of air power roles on offensive capability, air power plays a critical, non-combatant role in these operations, where its speed and reach make it ideal for the rapid deployment and projection of national power at the strategic level. Thus, using the human systems model approach, the separate theories for the employment of air power can be viewed as specific zones of a continuum of strategies to influence an adversary through will and means, using high or low levels of national power

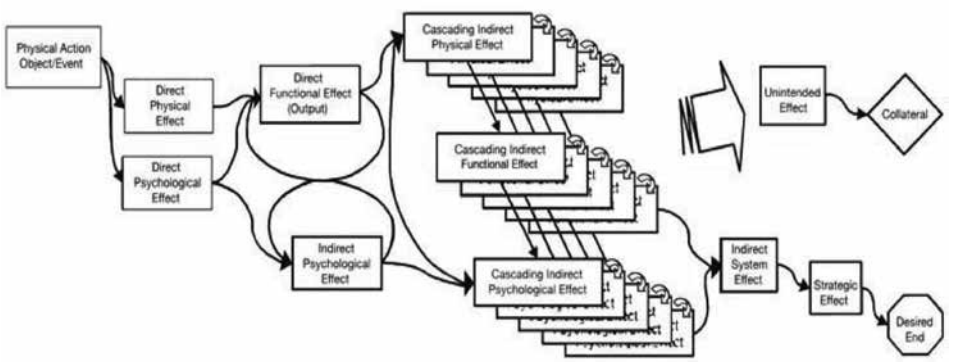
IMPORTANCE OF EFFECTS CASCADE AND CENTRES OF GRAVITY

On of the advantages of the human systems model over Warden's 5-rings

Rapid and repeated combinations of ambiguous, but threatening effects, and deceptive, but non-threatening ones" will reduce the accuracy of the match and lead to increasingly inappropriate responses. If the speed at which the cognitive component process information falls below the speed at which it receives it, decisions are more and more likely to be out of touch.

model and Boyd's OODA loop is that it provides a tool for predicting the route of cascading of physical and psychological effects, as they must travel along the links between activities and the activity and cognitive components (see Fig 8). Planners can 'shape' the effects of air power by knowing which elements and links need to be preserved for the effects cascade and which need to be disrupted to initiate it. Effects must be shaped to influence the CofG consistent with the desired political objectives. Analysis of elements and links is necessary to identify their relative importance to the CofG, their vulnerability to kinetic and non-kinetic effects and the permissibility of applying national power against them.

Fig 8: The Cascade Effect



Source: Adapted from Smith, 2002, p. 31, and Enderby et al., 2002, p. 33.

Overall, focussing air power on influencing the adversary's means is a less effective use of air power than influencing the adversary's will, because its effect is primarily constrained to the operational level. Air

power was particularly effective when the effects created by its employment were able to cascade through the adversary's systems. However, the complexity and non-linear response capability of human systems means that it is very difficult to analyse the effects cascade and the adversary's strategic response. This analysis differs slightly from Operational Net Assessment (ONA) in that the primary focus of ONA is on the targeting of physical nodes to achieve effects, whereas the human systems approach is focussed on understanding system activities and outputs; the selection of physical targets occurs after the desired effect cascade has been selected. Both forms of analysis require a very high level of information about the adversary. Sun Tzu's dictum, "know the enemy and know yourself; in a hundred battles you will never be in peril" is even truer in the modern age. The human system model indicates that the most effective way to employ air power is to approach each adversary as a unique rather than generic opponent, conduct detailed analysis of his systems to identify the inputs, resources and decisions that are critical requirements for the CofG, and tailor a campaign plan aimed at attacking his critical vulnerabilities that enable the application of air power to have decisive effect.

Despite the concentration of air power roles on offensive capability, air power plays a critical, non-combatant role in these operations, where its speed and reach make it ideal for the rapid deployment and projection of national power at the strategic level.

OPERATION INHERENT RESOLVE

This is the latest battle in the Gulf wherein terrorist groups from all over have gathered under a single flag to form a Caliphate. They have six battalions worth of troops with independent C2. Hence, a case of multiple CofG. They also change the local commanders catering for the drone attacks. They are highly motivated and are well versed in air attack strategy. Albeit it is too early to draw any lessons, one can state comfortably that a wrong template has been used.

CONCLUSION: THE UTILITY OF THE HUMAN SYSTEMS MODEL

The human systems approach is an all-encompassing construction offering an explicitly holistic view of the adversary as systems, links and elements. The model also provides a conceptual framework for understanding the cascade of direct and indirect physical and psychological effects through systems. This provides the starting point for detailed campaign planning by helping planners categorise the elements and links of an adversary's system. This enables them to visualise the CofGs that may exist at the strategic, operational, and tactical levels. Campaign planners can then analyse critical capabilities, requirements and vulnerabilities and conceive means to influence them in a way that will achieve political objectives Political objectives and the properties of the CofG guide the selection of national power needed to induce effects, and the level of force to apply, if any. The range of strategic options identified by the human systems model, and their varying effectiveness, indicate that it is important that the application of force on a critical vulnerability be directly linked to influence on a CofG. In turn, the disruption, destruction or neutralisation of a CofG must be coherently linked to the desired political objectives. A key strength of the human systems model is that the interdependence of the cognitive and activity components overcomes the tendency of Warden's approach to assume that a 'template' campaign can be applied to any adversary. Implicit in Warden's model is that an adversary will comprise broadly the same systemic construction as the United States and that the adversary's systems are 'static', unresponsive. The human system model inherently assumes that an adversary's systems are unique and can respond to attempts to influence them. This requires military planners to anticipate the dynamic interaction of friendly and adversary powers and likely adversary courses of action. Finally, it overcomes the criticism of Boyd's OODA loop model that it provides no practical guidance for the implementation of coercive or paralysis strategies. However, the human system model provides guidance on what has to be done, but the operational art is still the preserve of the commander's judgment.