# ILLUMINATING THE SHADOWS OF WAR:

# DEMYSTIFYING COMPLEX ADAPTIVE SYSTEMS

BY

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14. ABSTRACT

**Not all complex adaptive systems are equal. While some systems succeed in very challenging situations, others fail. Rather than treating all complex adaptive systems as the same as the DoD does, this thesis sets out to determine whether there are specific characteristics of a system that make one more resilient and survivable than another. To accomplish this task, this study assesses the purpose, leadership, and organization of two major complex adaptive systems. The first case study conducts an analysis of Hezbollah, arguably a very successful system, during its war with Israeli in 2006. This study reveals that Hezbollahs success was due in part to their clearly communicated and consistent purpose, delegated leadership philosophy, and flattened organizational structure. The second case study provides an analysis of Germanys military-industrial complex failure during WWII. The analysis of Germany reveals that not only are the individual characteristics of the system important to its resiliency and survivability, but so are the interactions between those individual characteristics. Germanys leadership failed to adjust accordingly the systems strategic guidance when it expanded Germanys strategic goals during WWII. Additionally, Germanys preference for centralized leadership and decision making was incompatible with its reliance on horizontal organizational structures. Consequently, the German military-industrial complex was unable to withstand the pressures imposed by the Allies, and it failed to develop effective new technologies during the war. In the end, being able to anticipate the resiliency of the adversary is important to the strategist and planner as they must allocate time, effort, and resources to those friendly systems charged with exerting control or influence over an adversarys system**

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APPROVAL

The undersigned certify that this thesis meets masters-level standards of research, argumentation, and expression.

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Col (Dr.) G. Scott Gorman (Date)

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Dr. James W. Forsyth (Date)

DISCLAIMER

The conclusions and opinions expressed in this document are those of the author. They do not reflect the official position of the US Government, Department of Defense, the United States Air Force, or Air University.

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Major Jeff Valenzia graduated from the Reserve Officer Training Corps at San Diego State University. Following several years as an adjutant and Command Post Controller, he went on to attend Undergraduate Pilot Training in 1998. From pilot training, he went on to fly the F-16 at Shaw AFB, Osan AB, and Luke AFB. Major Valenzia is a senior pilot with over 1500 flying hours. He has a bachelor's degree in Sports Medicine, a master's degree in Human Factors from Embry-Riddle Aeronautical University, and a master's degree in Military Arts and Sciences from Air University. In July 2009, Major Valenzia was assigned to the Strategy Division at Al Udeid.

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ABSTRACT

Not all complex adaptive systems are equal. While some systems succeed in very challenging situations, others fail. Rather than treating all complex adaptive systems as the same as the DoD does, this thesis sets out to determine whether there are specific characteristics of a system that make one more resilient and survivable than another. To accomplish this task, this study assesses the purpose, leadership, and organization of two major complex adaptive systems. The first case study conducts an analysis of Hezbollah, arguably a very successful system, during its war with Israeli in 2006. This study reveals that Hezbollah's success was due in part to their clearly communicated and consistent purpose, delegated leadership philosophy, and flattened organizational structure. The second case study provides an analysis of Germany's military-industrial complex failure during WWII. The analysis of Germany reveals that not only are the individual characteristics of the system important to its resiliency and survivability, but so are the interactions between those individual characteristics. Germany's leadership failed to adjust accordingly the system's strategic guidance when it expanded Germany's strategic goals during WWII. Additionally, Germany's preference for centralized leadership and decision making was incompatible with its reliance on horizontal organizational structures. Consequently, the German military-industrial complex was unable to withstand the pressures imposed by the Allies, and it failed to develop effective new technologies during the war. In the end, being able to anticipate the resiliency of the adversary is important to the strategist and planner as they must allocate time, effort, and resources to those friendly systems charged with exerting control or influence over an adversary's system.

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## Introduction

The development of a military strategy requires confronting the difficult task of linking available military means to a desired political end. To accomplish this task, the military strategist must understand the nature of the adversary system which stands in the way of this desired political end. The challenge is that linking means to an end requires assumptions about how an adversary system will react to a specific military action. These assumptions, in fact, are exactly what comprise campaign plans—if we do this, the adversary will respond by doing that. This is difficult, however, because adversary systems are complex and adaptive—complex adaptive systems behave in unpredictable ways and are highly resilient to changes imposed by an opposing system. The bad news: all adversary systems are complex and adaptive. The good news: not all complex adaptive systems possess the same degree of resiliency or survivability.

Military strategists require the means to categorize effectively the degree of complexity and adaptability of adversary systems. This is critical because the greater the complexity and adaptability of a system, the greater a system's resiliency and survivability, and the greater the time, effort, and resources required to influence the system's behavior. For example, both a platoon of tanks and a flight of fighter aircraft are complex adaptive systems. However, because of the nature of the media they each operate in the behavior of an advancing tank requires far less time, effort, and resources to control as compared to the fighter aircraft. Military forces can employ fairly easy defensive measures to delay or halt the advance of a platoon of tanks, such as tank traps, ditches, and other mechanical defenses. Whereas, the defense network required to prohibit the advance of a flight of fighters is far more complex. It may require a complex network of technologically advanced and integrated air defense systems utilizing anti-aircraft artillery, surface-to-air missile systems, radar detection networks, and defensive counter-air fighters. The possible courses of action, i.e. degrees of freedom, available to the flight of fighters makes, by comparison, it more resilient than the platoon of tanks. While this illustration appears straightforward, consider the analysis necessary when assessing the amount of time, effort, and resources required when confronting an adversary such as Hezbollah. Apportionment of time, effort, and resources to influence

Hezbollah's behavior is directly proportional to its ability to survive in a hostile and rapidly changing environment.

The purpose of this thesis is to identify those characteristics of a complex adaptive system that increases its resiliency and survivability. It is paramount for the military strategist to understand what it means for a system to be complex and adaptive, and to possess the ability to identify those characteristics of a system that make it more, or less, survivable. This thesis will aid military strategists in three ways: (1) avoid the overuse of the label complex adaptive system by educating the military strategist on what the term really means, (2) provide a qualitative tool for military strategists to recognize the degree of resiliency and survivability of a system, and (3) enable military strategists to allocate the necessary amount of time, effort, and resources to those friendly systems tasked with confronting a resilient adversary system. The remainder of this chapter addresses the first point above—what it means when a system is complex and adaptive.

**What is a complex adaptive system?**

To be a complex adaptive system, a system must consist of independent parts, possess a common purpose, and must continually interact and respond to changes in its environment in novel ways.[1] Murray Gell-Mann further describes a complex adaptive system as a system that receives a stream of data about itself and its surroundings. By utilizing the stream of data, a system must be capable of identifying patterns and regularities, and compressing them into a concise "schema," which influences its future behaviors.[2] Systems use schemata to organize current knowledge to create a model or framework to aid the system in future operations.

This ability to develop schemata is the key difference between a complex adaptive system and any other system. The schemata provide the complex adaptive system the capacity to learn and modify its behavior and/or structure as it gains experience interacting with its environment. Complex adaptive systems surround us every day, and each of us are part of a dozen different complex adaptive systems at any one time. Social organizations such as labor unions, political parties, and even a church Bible study group

[1] Garnett P. Williams, *Chaos Theory Tamed* (Washington, D.C. : Joseph Henry Press, 1997), 234.
[2] David S. Alberts and Thomas J. Czerwinski, eds., *Complexity, Global Politics, and National Security* (Washington D.C.: National Defense University (Ndu), 1997), 8.

are all examples of complex adaptive systems in social systems. In nature, complex adaptive systems range from the tiny cardiovascular system of a bird, to the complexity of a human brain, and include the vastness of the entire ecosystem. Complex adaptive systems are everywhere.

First, all complex adaptive systems must be a system. A system, as defined by Robert Jervis, must have at least two elements interconnected where changes in some elements or their relations produce changes in other parts of the system. Additionally, the entire system must exhibit properties and behaviors that are different from those of the parts.[3] For example, a system in one of the simplest forms is a pair of pliers. Pliers typically include at least two parts, when used together they create a mechanical advantage allowing the user to accomplish a task outside of their normal capacity.

The complexity of a system comes not from just two parts, but from a great many parts interacting with each other in a great many ways.[4] Consider a car as a complex system. Not only is a car complex, but it is also complicated, and these two terms have very different meanings. To be complicated, a system must simply possess a great many parts, however, the parts do not interact. Complexity, on the other hand, requires the great many parts to interact in a great number of ways. For example, the driver's seat of a car contributes to the car's complication, but not its complexity. The removal of the driver's seat will make it difficult to drive the car, but not impossible. Conversely, the removal of the car's alternator renders the car useless. The alternator of the car, therefore, contributes to both the car's complication, and its complexity.

Unpredictable behavior is the hallmark trait of all complex adaptive systems. The adaptive nature of complex adaptive systems allows them to respond to changes in their environment in novel and unique ways. This is due to two implicit characteristics of complex adaptive systems: nonlinearity and sensitivity to initial conditions.

Unpredictable behavior and organizational change within a complex adaptive system is due to the nonlinear relationship between the system's inputs and outputs. Nonlinearity within a system occurs when small changes in the environment or stimuli

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[3] Robert Jervis, *System Effects* (Princeton: Princeton University Press, 1997), 6.

[4] M. Mitchell Waldrop, *Complexity: The Emerging Science at the Edge of Order and Chaos* (New York, NY: Simon & Schuster, 1992), 11.

yield a response within the system disproportionate to the stimulus.[5] Nonlinearity is the norm in nature, as shown in recent scientific studies ranging from the turbulence of fluids to modeling human behavior. This is not, however, a newly discovered phenomenon. Over 100 years ago the mathematician Henri Poincare demonstrated how the motion of as few as three interactive bodies (such as the sun, the moon, and the earth), although governed by strict scientific laws, defied exact solution.[6] Poincare's discovery illustrated how a small change in one of the three bodies created a disproportionate, and unpredictable, change in the entire system. A linear system (or even a two-body problem), by contrast, will follow well-defined and predictable responses to observed changes in the system's environment.[7] For example, an automobile able to travel 250 miles on 20 gallons should also be able to travel 500 miles on 40 gallons of gas. While the relationship between a system's inputs and its outputs are observable, measurable, and predictable in a linear system, they are not in a non-linear system.

Furthermore, a complex adaptive system's sensitivity to initial conditions helps to explain the nature of its unpredictable behavior. Edward Lorenz, a meteorologist and mathematician, was the first to observe how a system's sensitivity to its initial conditions could generate great variation in its output. While studying the effects of twelve variables on a computerized model of weather patterns, Lorenz observed that while his weather model obeyed mathematic principles, the behavior of the model never repeated itself.[8] As repetition is one of the principles of mathematics, the significance of this discovery was not lost on Lorenz. Lorenz's discovery came to him when he attempted to replicate a scenario observed in the model when he printed and inputted the initial conditions of the original scenario back into the computer model. In an attempt to quicken the data entry, Lorenz entered the initial conditions of the model to the thousandth decimal point, rather than out to the millionth decimal point. Lorenz presumed the small decimal difference between the values would have a negligible effect on the outcome. However, what he soon observed defied expectations and soon became

[5] Williams, *Chaos Theory Tamed*, 10.
[6] Alberts, *Complexity, Global Politics, and National Security*, 46.
[7] G. Nicolis, *Introduction to Nonlinear Science* (Cambridge, England: Cambridge University Press, 1995), 1.
[8] James Gleick, *Chaos: Making a New Science* (Boston: Penguin (Non-Classics), 1988), 9-31.

widely known as the butterfly effect. The minute difference in the initial conditions resulted in a disproportionately large change in the system's output. As a point of illustration, the flap of the wings of a butterfly in New York could theoretically initiate a chain reaction resulting in a hurricane in the Philippines. As the result of a complex adaptive system's sensitivity to its initial conditions, the observed behavior often appears unpredictable due to limitations in observing precisely the system's initial conditions.

A common misconception is chaos is somehow responsible for a system becoming complex and adaptive. A recent study arguing against the efficacy of effects-based operations (EBO), Australian Army officers Justin Kelly and David Kilcullen concluded, "[c]haos makes war a complex adaptive system, rather than a closed or equilibrium-based system."[9] The problem with this statement is that chaos is not a force that has the ability to exert influence on a system, but a state of a system.

A system in a state of chaos, according to Garnett Williams in *Chaos Theory Tamed*, is in a sustained and disorderly-looking long-term evolution satisfying certain special mathematical criteria.[10] M. Michael Waldrop in *Complexity* suggests there are at least two states for any system; order and chaos. The unique characteristic of a complex adaptive system, Waldrop points out, creates a third state, striking a special balance between order and chaos—the edge of chaos.[11] On the edge of chaos, a complex adaptive system avoids the stability of order and the randomness of disorder, and instead maintains a nimbleness allowing it to survive despite a constantly changing environment.

In sum, complex adaptive systems are systems with many interactive parts changing in response to its environment. The design of a complex adaptive system ensures its continued survival and the achievement of its desired purpose. So why do some complex adaptive systems survive while others fail? For example, why are we not cohabitating the earth with dinosaurs? Clearly, some complex adaptive systems are less resilient to changes in its environment, whereas others continue to survive in the most demanding environments. Why? Presumably, one of the prerequisites for survival is to be more resilient and survivable than your competitor. The most important question in

[9] Justin Kelly and David Kilcullen, "Chaos Versus Predictability: A Critique of Effects Based Operations," *Australian Army Journal*, vol II, no. 1 (Winter 2004): 66.
[10] Williams, *Chaos Theory Tamed*, 9.
[11] Waldrop, *Complexity*, 12.

the end is what are the characteristics of a complex adaptive system that make it more resilient and survivable?

**Roadmap**

In search for those characteristics of a complex adaptive system that contribute to a system's resiliency and survivability, this thesis will examine two separate complex adaptive systems. The first study will assess Hezbollah during its war with Israel in 2006. The Hezbollah case study will provide the opportunity to assess the characteristics of a flat, elastic system able to survive the invasion of a militarily superior adversary. The second case study provides an assessment of the rigid and hierarchical German military-industrial complex during WWII. The German case study specifically looks to those characteristics of a once successful system that subsequently suffers defeat. Before delving into the case studies, chapter two presents a single, simplified methodological framework to search for those characteristics in a complex adaptive system that make it more survivable. Chapter three uses this framework to assess Hezbollah during the Israeli-Hezbollah War in 2006. Chapter four applies the same framework through the assessment of the German innovation of new technologies during WWII.

## Chapter 1

### Framework for the Analysis of a Complex Adaptive System

What are the characteristics of a complex adaptive system that enhance its ability to adapt to changes in its environment, i.e. the system's resiliency and survivability? To answer this question, we must first build a framework for analysis universal to all complex adaptive systems. The difficulty in creating such a framework is the growing literature regarding complex adaptive systems has produced nearly as many descriptive frameworks as there are complex adaptive systems.

Robert Jervis in *Systems Effects* describes complex adaptive systems with three characteristics; emergence properties, dense interconnections, and use of feedback.[1] Robert Edson, of the Applied Systems Thinking Institute, created a Conceptagon of seven triplets of system characteristics. Edson's intent for his 21 characteristics of a complex adaptive system, which include assessing a system's transformation of information and parsimony, is to create a complete assessment and understanding of all complex adaptive systems.[2] Militarily, in an attempt to describe the complexity of land combat, Andrew Ilachinski, a physicist specializing in complex adaptive systems, identifies eight generic properties of complex adaptive systems, using terms such as non-reductionist, and collective dynamics.[3] Further, Garnett Williams in *Chaos Theory Tamed* narrows the properties of complex adaptive systems down to only six "ingredients,"[4] and Seth Lloyd of MIT recommends looking at 42 different measures to assess the degree of complexity

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[1] Robert Jervis, *System Effects* (Princeton: Princeton University Press, 1997), 15, 17, and 125.

[2] Robert Edson, Systems Thinking. Applied. A Primer, Applied Systems Thinking Institute, 21 July 2008, 31, http://www.asysti.org/ (accessed 23 September 2008): (1) Boundary, Interior, and Exterior; (2) Inputs, Outputs, and Transformation; (3) Wholes, Parts, and Relationships; (4) Structure, Function, and Process; (5) Command, Control, and Communications; (6) Variety, Parsimony, and Harmony; and (7) Emergence, Hierarchy, and Openness

[3] Andrew Ilachinski, *Land Warfare and Complexity, Part II: An Assessment of the Applicability of Nonlinear Dynamic and Complex Systems Theory to the Study of Land Warfare* (Alexandria: Center For Naval Analysis, 1996), 2: (1) Nonlinear interaction, (2) Nonreductionsist, (3) Hierarchical structure, (4) Decentralized control, (5) Self-organization, (6) Nonequilibrium order, (7) Adaptation, and (8) Collective dynamics.

[4] Williams, *Chaos Theory Tamed*, 234: (1) they have large number of parts, (2) the parts continuously interact and respond to their fellow parts in novel ways, (3) the system adapts in response to changes in its environment to ensure the system's survival, (4) the parts within the system self-organize, (5) local rules govern all parts of the system, and (6) over time the system becomes increasingly complex, efficient, and sophisticated.

of a system.[5] The challenge in creating a framework for understanding the subject of complex adaptive systems is to first create an analytical tool less complex then the system itself. Interestingly, the most useful constructs for analyzing a complex adaptive system do not come from the field of complexity but from notable military theorists, such as, Carl Von Clausewitz, J.F.C. Fuller, and Shimon Naveh, and modern-day systems theorists, such as John Boardman and Brian Sauser.

Nearly 200 hundred years ago, and almost 100 years before Henri Poincare's study of the three-body problem, Carl Von Clausewitz pointed out the complexities in war in what he termed the paradoxical trinity. War, according to Clausewitz, is the use of physical force by some nation or state to compel another nation or state to do their will.[6] War itself is not a complex adaptive system; however, the actors engaged in the physical struggle are. In an effort to explain the complexity and adaptability of an adversary in war, Clausewitz introduced three blind natural forces in war: violence, reason, and chance.[7] These forces interact with each other in a way similar to Poincare's three-body problem and help to illustrate the total phenomenon of war. Clausewitz further expounded on his paradoxical trinity by attributing violence to the entity's army, chance to their government, and reason to their population (fig. 1). What emerges are categorical representations common to all actors engaged in war; a military force, a government, and a population. Every nation or state engaged in war will possess some form of military, some form of governance, and some form of a population. The challenge becomes recognizing what forms of military, government, and population make a nation or state more survivable than their adversary.

[5] Seth Lloyd, *Programming the Universe: A Quantum Computer Scientist takes on the Cosmos*, (New York, NY: Alfred A. Knopf, 2006), 189.
[6] Carl Von Clausewitz, *On War*, trans Michael Howard and Peter Paret (Princeton: Princeton University Press, 1989), 75.
[7] Clausewitz, *On War*, 89.

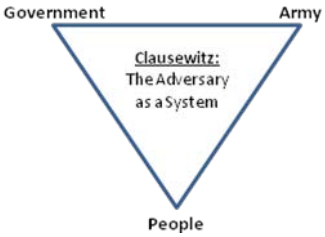


**Figure 1: Clausewitz's Paradoxical Trinity**
Source: Author's original work

Nearly a century later, British Army officer, military historian, and strategist, J.F.C. Fuller, reinforced Clausewitz's trinity when attempting to explain scientifically the complexities and adaptations he observed in war as the result of recent technological developments. In the early 1900s, Fuller set out on the ambitious task of developing a scientific theory and practice to the study of war.[8] Fuller was in search of a construct to explain why one adversary was more successful in war over another.[9] In his construct (fig. 2), Fuller suggested the development of a military strategy began in the brain (mental sphere), flowed through the heart (moral sphere), and finally concluded in the muscles (physical sphere). Therefore, it was specific qualities within these three spheres resulting in success on the battlefield.


**Figure 2: Fuller's General Relationship of the Elements of War**
Source: Author's original work

Rather than viewing Fuller's construct in a linear manner, consider it as a trinity where all three spheres interact. Fuller's construct suggests the only means for a general and his commanders to affect the physical strength of their fighting forces is through the manipulation of their moral strength. According to Fuller, the control of the moral

[8] Colonel J.F.C. Fuller, *The Foundations of the Science of War* (London: Hutchinson & Co, Ltd, 1926), 324.
[9] Fuller, *The Foundations of the Science of War*, 16.

strength of the fighting forces allows the forces to execute the will of the general. In truth, the moral strength of the forces can come from many sources outside of the general and his commanders, such as, social, physical, and ideological sources. The courage required for an individual to participate in a successful offensive attack may come from the individual's belief in the cause, independent of the general's, i.e. a religious crusade. Additionally, the courage required for an individual to make a successful defensive stance against an invading adversary may come from the nature of the defense, i.e. the defense of their home or village, and not just the commander's moral fortitude. Therefore, the nature of the conflict plays heavily on the moral strength of the fighting forces; and it is not necessarily limited to the moral strength supplied by the general and his commanders. To suggest the only linkage for a general to influence the physical strength of their forces is through the moral sphere ignores the critical role the general plays in directly shaping the physical strength of the forces. The equipment, command, and control of the forces are all elements in which the general influences greatly their physical sphere. Consequently, the mental sphere interacts directly with the physical sphere. Therefore, a trinity, rather than a linear relationship best represents Fuller's three spheres of influence (fig.3).

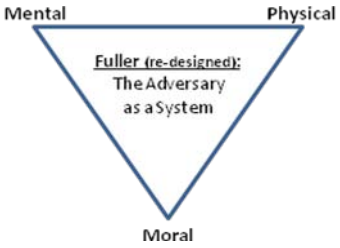


**Figure 3: Fuller's Construct (Re-Designed)**
Source: Author's original work

Shimon Naveh, a retired brigadier general from the Israeli Defense Force and a modern-day military theorist, developed an operational approach to warfare combining military theory with systems theory. Naveh recognized every system constitutes an essential triad; its heart, its brain, and its self-regulating agency (fig. 4).[10] The heart is

[10] Shimon Naveh, *In Pursuit of Military Excellence: The Evolution of Operational Theory* ( New York: Routledge, 1997), 14.

where the system selects its desired purpose and defines concrete objectives and detailed missions. With a purpose in hand, the system's brain must develop and execute a coherent plan to achieve the desired purpose. Finally, the system's self-regulating agency represents its ability to overcome external disturbances and to restore its operational equilibrium, a procedure which permits it to adhere to its final objectives.[11]

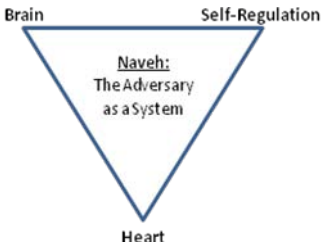


**Figure 4: Naveh's Adversary System Theory**
Source: Author's original work

John Boardman and Brian Sauser's work in *Systems Thinking: Coping with 21st Century Problems*, offers a non-military framework relevant to this study of complex adaptive systems. Boardman and Sauser, using an engineer's approach, conclude every system must have a form, a function, and a utility (fig. 5).[12] By form, they mean every system must have a shape or structure; the system's function pertains to its behavior and dynamism; and the system's utility provides it a purpose. Sharing Fuller's fascination with trinities, Boardman and Sauser conclude this trio of form, function, and utility are instrumental to finding a systems model to help the to understand what makes a system more survivable.

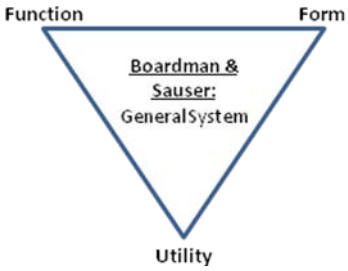


**Figure 5: Boardman and Sauser's General Systems Theory**
Source: Author's original work

[11] Naveh, *In Pursuit of Military Excellence*, 15.
[12] John Boardman and Brian Sauser. *Systems Thinking: Coping with 21st Century Problems* (Boca Raton: CRC, 2008), 22.

Through this sampling of relevant literature spanning over a 100 years and from widely different perspectives, a common thread emerges that will aid in our search for those characteristics that make a complex adaptive system more resilient to the challenges imposed by a hostile and rapidly changing environment. Lacing all four theories together provides a useful framework in the assessment of various complex adaptive systems. It is evident from this sampling that all complex adaptive systems must possess a purpose, leadership, and an organization (fig. 6).

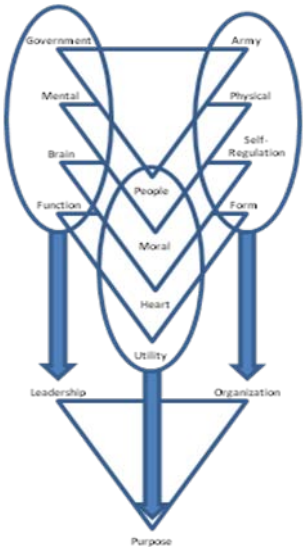


**Figure 6: Distilled Framework for Analysis**
Source: Author's original work

Common to all four models is the notion all systems must possess an overall purpose. According to Clausewitz, the people possess the passion and the hatred, which is necessary when waging war.[13] "[T]he spirit that permeates war as a whole, and at an early stage [the people] establish a close affinity with the will that moves and leads to the whole mass of force, practically merging with it, since the will is itself a moral quality," according to Clausewitz.[14] It is within this passion the population will derive their purpose for waging war. In a complementary fashion, Fuller's moral sphere captures the importance of the system's purpose, "the domain of the soul, ego, or 'heart'… [w]ithin it lie hidden the instincts of man, and of these the strongest in war is the instinct of self-

[13] Clausewitz, *On War*, 89.
[14] Clausewitz, *On War*, 184.

preservation."[15] Furthermore, Naveh recognizes the importance of the system's purpose as the heart of the system. It is within the heart the system breaks down its purpose into concrete objectives and detailed missions.[16] Finally, Boardman and Sauser identify the system's utility as the source of its overall purpose.

The element of leadership is a common thread through these four models. Clausewitz's government, Fuller's mental strength, Naveh's brain, and Boardman and Sauser's function of a system, all single out the system's leadership as a common element. Two thousand five hundred years ago, Chinese philosopher, Sun Tzu, recognized the overwhelming importance of leadership in war. Sun Tzu's famous dictum from *The Art of War*, "[k]now the enemy, know yourself; your victory will never be endangered," is as much about the leadership of the army as an insinuated endorsement of military intelligence.[17] Clausewitz also placed undying reliance on the military commander as the determining factor for victory in war. He qualified it as not just the commander, but the commander who possesses genius "in the darkest hour retains some glimmerings of the inner light, which leads to truth and the courage to follow this faint light wherever it may lead."[18]

Finally, Clausewitz's army, Fuller's physical strength, Naveh's self-regulation, and Boardman and Sauser's form illustrates the importance of organization in a complex adaptive system. The challenge in studying the structure of a complex adaptive system is the prevailing literature is unclear as to the most effective design. Gareth Morgan, in *Images of Organization*, notes the thrust of classical management theory and its modern applications suggest organizations can or should be rational systems that operate in as efficient a manner as possible.[19] Mechanistically, this has meant success comes from a highly structured, hierarchical organization. The most successful organizations compartmentalize the various functions, roles, and people within the organization.[20] In contrast, in the 1920s and 1930s, research sponsored by Hawthorne Studies drew parallels between the natural sciences and organizational theories. Researchers

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[15] Fuller, *The Foundations of the Science of War*, 115.
[16] Naveh, *In Pursuit of Military Excellence*, 15.
[17] Sun Tzu, *The Illustrated Art of War*, trans. Samuel B. Griffith (New York, NY: Oxford University Press, 2005), 205.
[18] Clausewitz, *On War*, 102.
[19] Gareth Morgan, *Images of Organization* (Thousand Oaks: Sage Publications, Inc, 2006), 22.
[20] Morgan, *Images of Organization*, 28.

recognized in the Hawthorne Studies the value of the individual and their interaction within the organization and their environment. Therefore, what emerged from these studies was the notion that interrelationships within an organization improved significantly the overall performance of the organization.[21]

All complex adaptive systems possess a purpose, leadership, and an organization. Although systems share these common traits, they differ greatly in how they satisfy each of these three systemic needs. The question, therefore, is what are the characteristics of a complex adaptive system, within these three categories, which make a system more resilient and survivable?

**A Caveat**

This thesis delves into the world of theory, which resists the absolutes associated with Newtonian science where the predictive value of mathematics reigned as the supreme source of explanatory power. The analytical framework used in this thesis requires the reader shed the need for concrete, numerical representations of facts. The utility of this study is to gain a better qualitative understanding of complexity and adaptability in a system, rather than to serve as a quantitative tool for analysis. In the end, military strategists and planners should never expect to develop the means to group complex adaptive systems into neat bundles where behavior is as predictable as the rising sun. Complex adaptive systems are innovative, surprising, and ultimately unpredictable—all we should hope to accomplish is to develop a better understanding of the degree of the resiliency and survivability of a complex adaptive system so we can at least bound its anticipated behavior.

[21] Morgan, *Images of Organization*, Chap 3.

## Chapter 2

## Hezbollah: From Underdog to Undefeatable

> *"Hezbollah, as an organization with the capability and worldwide presence, is [Al Qaeda's] equal, if not a far more capable organization. I actually think they're a notch above in many respects."*
>
> *George Tenant*

In the summer of 2006, Israel engaged Hezbollah in major combat operations in response to Hezbollah's kidnapping of two Israeli soldiers. What ensued was an unanticipated 34-day military clash in which Israel's armed forces failed to either recover the two kidnapped soldiers or affect Hezbollah's presence in Lebanon. Hezbollah, as a system, has proven to be highly resilient and survivable under very heavy opposition.

### History of Hezbollah

Hezbollah, the "Party of God,"[1] is to some an international terrorist organization, by other accounts a political activist organization, and still to others, a legitimate local governmental organization.[2] Founded in 1982 during the Lebanese Civil War, Hezbollah became a representative militia for the Shiite followers of the Ayatollah Khomeini.[3] Hezbollah's emergence as an organization with the capability and worldwide presence, commensurate with Al Qaeda, was due in large part to Iranian financial support and the manpower made available following the Palestine Liberation Organization's (PLO) defeat during Israel's invasion of South Lebanon in 1982.[4]

Israel's invasion of Lebanon on 5 June 1982, following an eleven-month cease fire with the PLO, created the environment from which Hezbollah rose. Israel's invasion was in response to what it claimed was a break in the cease fire agreement between Israel and the PLO when the Israeli ambassador to the United Kingdom, Shlomo Argov, was wounded badly in an attempted assassination. Israel's decision to attack the PLO in response to the attempted assassination may have been unwarranted as a renegade

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[1] Hezbollah, meaning the "Party of God" is from the Koran, sura 5, verse 56, which reads "lo! The party of Allah, they are the victorious."
[2] Michael T. Kindt, "Hezbollah: A State Within a State," in *Know Thy Enemy II: A Look at the World's Most Threatening Terrorist Networks and Criminal Gangs,* ed. Michel T. Kindt, et al. (Maxwell AFB, AL: USAF Counterproliferation Center, 2007), 243.
[3] Philippone, *Hezbollah*, 4.
[4] Philippone, *Hezbollah*, 4.

Palestinian group led by the infamous Sabri al-Banna, a blood foe of the PLO, likely carried out the attempted assassination. Although unwarranted, the attack had profound consequences.[5] Former Israeli Prime Minister Ehud Barak noted in 2006, "[w]hen [Israel] entered Lebanon there was no Hezbollah; it was [Israel's] presence that created Hezbollah."[6]

Iran and Syria shaped the development of Hezbollah following Israel's invasion of South Lebanon. Iran's involvement in the creation of Hezbollah was the most influential. For Iran, the creation of Hezbollah was the realization of the revolutionary state's zealous campaign to spread the message of the self-styled "Islamic revolution."[7] Syria, on the other hand, played Hezbollah from a Realpolitik perspective as support for Hezbollah strengthened their relationship with Iran, which in turn strengthened Syria's position in opposition to both Israel and the United States.[8]

Less than a year after Hezbollah's creation, the organization made its presence and name known with the 1983 Beirut bombing of the US Marine barracks, killing 241 Americans and injuring 60.[9] During the next two decades, Hezbollah gained greater notoriety with the American Embassy bombing in Lebanon in 1983 and 1984, the hijacking of TWA Flight 847 in 1985, the bombing of Union des Transports Aeriens Flight 722 in West Africa, the 1992 and 1994 bombings in South America, and the 1996 bombing of the US military barracks, Khobar Towers, in Saudi Arabia.[10] The world became very aware of Hezbollah's existence in a very short period of time.

Over the next 15 years, Hezbollah evolved from an Iranian-influenced terrorist organization that rejected Lebanese politics, to a party with considerable autonomy and a talent for winning elections.[11] Today, the Lebanese largely perceive Hezbollah as a legitimate government body, representative of and elected by the people. Within Lebanon, Hezbollah is responsible for running public services, building schools, building neighborhoods, participating in local government, and even operating fifty hospitals

[5] Augustus Richard Norton, *Hezbollah: A Short History* (Princeton: Princeton University Press, 2007), 33.
[6] Norton, *Hezbollah*, 33.
[7] Norton, *Hezbollah*, 34.
[8] Norton, *Hezbollah*, 35.
[9] Philippone, *Hezbollah*, 4.
[10] Philippone, *Hezbollah*, 5.
[11] Norton, *Hezbollah,* 6.

throughout Lebanon.[12] Today, Hezbollah's resiliency has made it a very successful system, not only as a regional threat to Israel, but also as a potential international threat.

**Hezbollah in action**

In July 2006, after months of increasing tensions between Israel and Hezbollah, Hezbollah executed a coordinated military operation to capture two Israeli Defense Forces (IDF) soldiers near Aita Shabb. Hezbollah's attack was one of a series of attacks in a tit-for-tat exchange between Israel and Hezbollah. Unforeseen by Hezbollah, the kidnapping of the soldiers provoked a major Israeli military response, resulting in Operations JUST RETURN, JUST REWARD, and CHANGE of DIRECTION. In the end, Israel's military response to the kidnappings left much of Hezbollah's constituency homeless and more than a thousand Shiite Muslim Lebanese dead.[13] Expecting to ride out a proportional response by Israel, Hezbollah instead faced a massive and overwhelming attack.

The conflict between Hezbollah and Israel illustrates nonlinearity in action. The kidnapping of two Israeli soldiers resulted in a 34-day conflict, displacing over 1.4 million people, and killing 1,142 civilians and 346 soldiers.[14] The conflict ended on 14 August 2006 with a UN brokered ceasefire, costing the Israelis nearly 500 million US dollars and the Lebanese more than four billion.[15]

Hezbollah's strategy since their inception in 1982 has evolved from guerilla tactics to a more hybrid strategy embracing both guerilla and conventional elements. Historically, Hezbollah has relied on the use of brute force to serve their larger coercive strategic ends.[16] For example, Hezbollah's reliance on terrorist bombings successfully resulted in the withdrawal of UN peacekeeping forces from Lebanon following the Beirut bombing of the US Marine barracks. Fast forwarding to 2006, Hezbollah adopted a much more conventional approach, evident by their willingness to establish defensive positions and hold ground with sustained engagements.[17] This differs from guerilla tactics which

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[12] Norton, *Hezbollah*, 15.
[13] Norton, *Hezbollah*, 7.
[14] "Middle East Crisis: Facts and Figures," *BBC News*, 31 August 2006, http://news.bbc.co.uk/2/hi/middle_east/5257128.stm (accessed 29 January 2009).
[15] "Middle East Crisis."
[16] Stephen Biddle, *2006 Lebanon Campaign and the Future of Warfare: Implications for Army and Defense* (Washington D.C.: Strategic Studies Inst U S Army War, 2008), 48.
[17] Biddle, *2006 Lebanon Campaign and the Future of Warfare*, 52.

typically entail ambush-type attacks with short engagements followed by the quick dispersion of the attackers.

An additional evolution in Hezbollah's approach to warfare was their effective use of complex weapons systems to support a larger strategy. Hezbollah's most publicized weapons system during the conflict was the Katyusha rocket. Although the 122mm Katyusha rocket posed little military threat to Israel, its 12 to 25 mile range made it possible for Hezbollah to threaten Israeli civilians.[18] In the end, Hezbollah employed nearly 4,000 rockets and successfully maintained a near constant barrage of weapons that disrupted many Israeli social and economic functions in northern Israel.[19] Hezbollah's strategy, in effect, forced the militarily superior Israeli armed forces to focus their efforts on countering the rocket attacks, thereby limiting their ability to mass forces in direct opposition to Hezbollah's stronghold in Lebanon. In the meantime, Hezbollah expertly manipulated the media and international opinion in an attempt to spark international condemnation of Israel's attack on Lebanon. Hezbollah recognized their task was not to defeat Israel, but to survive Israel's attack. In doing so, Hezbollah emerged a hero among many Islamic communities as they had successfully stood up to Israel and in the end prevailed.

On 12 July 2006, Ehud Olmert, Israeli Prime Minister, laid out a set of four objectives for Israel in response to Hezbollah's attack: (1) return of the two abducted soldiers, (2) imposition of a new order in Lebanon, particularly in southern Lebanon, (3) the strengthening of Israel's deterrent against external attack, and (4) the crushing of Hezbollah.[20] Hezbollah's resiliency proved more than Israel was prepared to handle as Israel failed to achieve three of its four stated objectives. As far as the first objective, in the end Israel failed to convince Hezbollah to return the two abducted soldiers. Israel's second objective, to impose a new order in southern Lebanon, also proved a bridge too far as Hezbollah emerged from the war with its support not only intact, but further bolstered by support from the Lebanese Shiite community.[21] In fact, following the war, Hezbollah received widespread respect, even admiration, from not only the Shiite

[18] Kindt, "Hezbollah: A State Within a State," 252.
[19] Kindt, "Hezbollah: A State Within a State," 253.
[20] William M. Arkin, *Divining Victory: Airpower in the 2006 Israel-Hezbollah War* (Maxwell Air Force Base, AL: Air University Press, 2007), 39.
[21] Norton, *Hezbollah,* 140.

communities throughout the Middle East, but also the Sunni Muslims. Hezbollah's military fortitude effectively galvanized all Palestinians living under Israel occupation and control.[22] Israel's third objective, to strengthen Israel's deterrence value may have been of some benefit, although it is nearly impossible to assess its effectiveness. Finally, Israel's fourth objective, to crush Hezbollah, proved to require far more effort than Israel was willing to expend.

**Analysis of Hezbollah as a System**

**Purpose.** Hezbollah possesses a single, clearly communicated purpose: to promote the spread of a pure Islamic government within the Middle East.[23] To accomplish this goal, Hezbollah has set out to eradicate the colonization of Westerners within Lebanon and destroy the state of Israel, as communicated in Hezbollah's "Open Letter:"

> We declare openly and loudly that we are an *umma* which fears God only and is by no means ready to tolerate injustice, aggression, and humiliation. America, its Atlantic Pact allies, and the Zionist entity in the holy land of Palestine, attacked us and continue to do so without respite. Their aim is to make us eat dust continually. This is why we are, more and more, in a state of permanent alert in order to repel aggression and defend our religion, our existence, our dignity. They invaded our country, destroyed our villages, slit the throats of our children, violated our sanctuaries, and appointed masters over our people who committed the worst massacres against our *umma*. They do not cease to give support to these allies of Israel, and do not enable us to decide our future according to our own wishes.[24]

Ultimately, Hezbollah views US support to Israel as the single force undermining their successful destruction of Israel and the creation of an Islamic government. Hassan Nasrallah, Secretary General of the Lebanese Islamic Party and Hezbollah, stated on the Hezbollah sponsored television network, al-Manar, "death to America will remain our reverberating and powerful slogan: Death to America."[25] Islam's main enemy, according

[22] Norton, *Hezbollah*, 149.
[23] Norton, *Hezbollah*, 39.
[24] "An Open Letter: The Hizbullah Program," *Jerusalem Quarterly*, no. 48, 16 February 1985, www.standwithus.com/pdfs/flyers/hezbollah_program.pdf *(accessed 1 April 2009)*.
[25] Philippone, *Hezbollah*, 6.

to Hezbollah, is the US because of their support to Israel, presumably resulting in the further suffering of Muslims in Lebanon.[26]

As a predominately Shiite community, the Muslim population of Lebanon looks toward Iran for spiritual leadership. During Hezbollah's formative years, Ayatollah Khomeini, the supreme political and religious authority in Iran, returned to power in Iran after gaining international notoriety following his expulsion for his role in encouraging the Iranian revolution. Imam Khomeini bolstered Hezbollah's purpose by providing it external legitimacy. Imam Khomeini has repeatedly stressed America is the reason for all of Islam's catastrophes and the source of all malice. By fighting the US, Imam Khomeini contends Muslims are exercising their legitimate right to defend Islam and the dignity of their nation.[27]

The beauty of Hezbollah's purpose is in its simplicity. Hezbollah's simple vision is clear, consistent, legitimate, and understandable for members and supporters alike. To remove any one of these characteristics would conceivably devalue the unifying power of Hezbollah's purpose. In effect, the characteristics of Hezbollah's purpose unify their many parts toward one common goal.

**Leadership.** Over the past 15 years Hezbollah has evolved from an Iranian-funded conspiratorial terrorist group rejecting participation in Lebanese politics, to a party bound by an intellectual structure founded on religious morals.[28] Ahmad Nizar Hamzeh in *In the Path of Hizbullah* characterized Hezbollah's form of governance as a Majoritarianism, combining democratic principles with majority rule.[29] Democratically, Hezbollah embraces the principles of freedom of choice, and an electoral system based on proportional representation of the people. Hezbollah uses these democratic principles in conjunction with the notion the world-wide Shiite population is entitled to a certain degree of primacy in society, i.e. majority rule. In essence, Hezbollah's vision of governance minimizes pluralism and encourages a process of homogenization of society. As reported on Hizbollah.org, "majoritarianism sees the political system as a melting pot

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[26] Norton, *Hezbollah*, 37.
[27] Norton, *Hezbollah*, 37.
[28] Amal Saad-Ghorayeb, *Hizbu'llah: Politics and Religion (Critical Studies on Islam Series)* (London: Pluto Press, 2002), 187.
[29] Ahmad Nizar Hamzeh, *In The Path Of Hizbullah (Modern Intellectual and Political History of the Middle East)* (Syracuse: Syracuse University Press, 2004), 29.

based on a universal criterion for power distribution, rather than on group-specific qualification."[30]

Although Hezbollah's form of government and the election of their leaders appears equivalent to Western democratic or social systems, it is fundamentally different. The difference lies in that Hezbollah subscribes to a doctrine of clerical supremacy, based on Ayatollah Khomeini's theory of guardianship of the jurisconsult, or *wilayat a-faqih*.[31] Guardianship of the jurisconsult believes only an imam, such as Khomeini, is capable of comprehending the sacred knowledge hidden in the Koran. This ability gives the imam God's appointed authority over the Islamic people. Therefore, what God delegated to the Prophet and the imams is delegated to the *wali al-faqih*, and "anybody who disobeys him or the jurists, disobeys God."[32] Although provisions to elect the leader of Hezbollah exist within their political ideology, Iran's leader Ayatollah Khomeini appointed the current Secretary General of Hezbollah. The significance of this nuanced appointment is the current Secretary General garnered instant credibility and legitimacy within Hezbollah and the greater Shiite community.

Hezbollah's Secretary General, Sheikh Hassan Nasrallah, came into power following Israel's assassination of the previous movement's leader, Abbas al-Musawi, in 1992.[33] As the Secretary General, Hassan Nasrallah is the organization's leader of the *Majlis al-Shura*, or Shura Council, Hezbollah's highest governing body.[34] Born in Lebanon in 1960, Nasrallah's radical views led him toward political activism early in his life. As a young man, Nasrallah joined the Shiite resistance movement developing in Lebanon during the 1970s. He quickly devoted his life to his religious and political practices, forming Hezbollah's initial core in 1982. Following a stint as the group's liaison with Iran, Iran's leader Ayatollah Khomeini appointed Nasrallah Secretary General following al-Musawi's assassination.[35] Nasrallah's rise to power is significant for two reasons: (1) as a member of Hezbollah from the beginning, Nasrallah developed credibility within the organization, and (2) Nasrallah's association with Iran lent him

[30] Hamzeh, *In The Path Of Hizbullah*, 29.
[31] Hamzeh, *In The Path Of Hizbullah*, 31.
[32] Hamzeh, *In The Path Of Hizbullah*, 33.
[33] Kindt, "Hezbollah: A State Within a State," 246.
[34] Arkin, *Divining Victory*, 22.
[35] Kindt, "Hezbollah: A State Within a State," 248.

credibility external to the organization. Additionally, Nasrallah's appointment by the supreme leader of the Shiite movement, Ayatollah Khomeini, provided him with indisputable authority over the organization, although Nasrallah acknowledges "the decision of peace and war is in the hands of the jurisconsult, not in the hands of the intellectuals, researchers, scientists, [or] regular politicians."[36]

Rather than relying on the unitary leadership of the Secretary General, Hezbollah has created an elaborate collective leadership structure responsible for strategic direction and policy for the organization. At the heart of Hezbollah's leadership and decision making process is the Shura Council. The Shura Council comprises seven individuals elected by the *Majlis al-Markazi*, or the Central Council—an assembly of almost two hundred party founders and cadres—for a period of three years.[37] The Shura Council provides Hezbollah with a centralized leadership and decision making body. Responsible for the overall administration, planning, and policy making for the organization, the Shura Council's decisions are final and religiously binding all party members.[38]

While the Shura Council provides the strategic direction for the organization, Hezbollah delegates the actual operation of the party to the Administrative Apparatus, known as the *Shura Tanfiz*. The Administrative Apparatus consists of five separate councils headed by a member of the Shura (fig. 7). The councils include; Executive Council, Judicial Council, Parliamentary Council, Politburo, and Jihad Council. The most significant of these councils is the Executive Council. The Executive Council oversees the delegation of key functions of Hezbollah from the central down to the local level.[39] The importance of the Executive Council is to ensure the various regions, sectors, and branches of Hezbollah execute the Shura Council's strategic decisions. The Judicial Council consists of Hezbollah's judges and judicial officials. The Judicial Council's primary function is conflict management and resolution within the Shiite community. The Parliamentary Council's role is to tighten party discipline and strengthen the effectiveness among Hezbollah's representatives in the Lebanese parliament. The Politburo functions as an advisory council to the Shura Council on

[36] Hamzeh, *In The Path Of Hizbullah*, 33.
[37] Hamzeh, *In The Path Of Hizbullah*, 45.
[38] Hamzeh, *In The Path Of Hizbullah*, 47.
[39] Kindt, "Hezbollah: A State Within a State," 244.

issues regarding the promotion of the party's political interests and is responsible for seeking support for Hezbollah's policies and programs. Finally, the Jihad Council's role is to decide on the strategies and tactics of the organization's commitment to jihad.

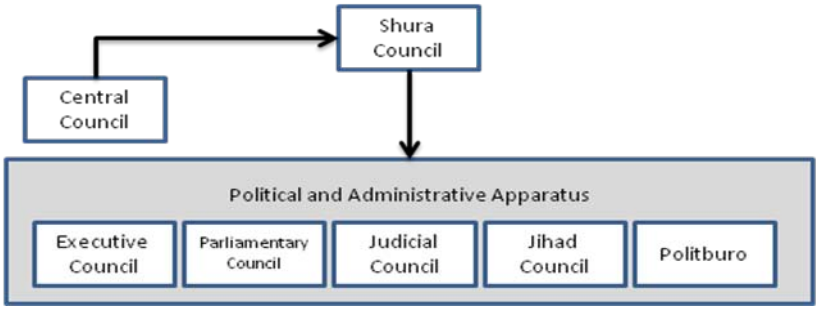


**Figure 7: Hezbollah's Leadership Structure**
Source: Author's original work

Hezbollah's leadership structure is significant because of its complexity and intricate design which balances the benefits of a centralized decision making, the Shura Council, with the benefits of delegated execution, the Administrative Apparatus. Furthermore, an elaborate communications structure allows Hezbollah's leadership to disseminate their strategic guidance to the members and supporters of Hezbollah's party.

Hezbollah's media wing, operated by the Executive Council, maintains a communication network capable of disseminating information to all facets of Hezbollah's party, and beyond. The media wing operates at least five newspapers, four radio stations, and a satellite broadcast television network, al-Manar (The Beacon).[40] Hezbollah's al-Manar TV reaches 200 million people worldwide, providing Hezbollah with both an internal and external communication capability.[41] Al-Manar officials believe their television station ranks among the top five most-watched stations throughout the Arab world and estimate the station draws approximately ten million world-wide viewers daily.[42] The ability for Hezbollah to communicate throughout its entire organization is instrumental in the unification and harmonization of all parts within its system.

Hezbollah has also created a highly capable communication structure between the sub-organizations within its system. Hezbollah's flattened military structure, supported

[40] Kindt, "Hezbollah: A State Within a State," 244.
[41] Philippone, *Hezbollah*, 15.
[42] Avi Jorisch, "Al-Manar: Hizbollah TV, 24/7," *Middle East Quarterly*, Winter 2004, http://www.meforum.org/583/al-manar-hizbullah-tv-24-7 (accessed 1 April 2009).

by an elaborate communication structure proved to be highly adaptive in defending against Israel's invasion in 2006. This facilitated Hezbollah's quick and effective transition between conventional and guerilla tactics during the Israeli-Hezbollah War. Hezbollah mounted a traditional, conventional defensive "secure-and-hold" strategy for some territories, while resorting to classic guerilla "hit-and-run" tactics for others. Hezbollah effectively coordinated the efforts of multiple fighting units, engaging in firefights lasting from hours to days in defense of strategic priorities such as Bint Jubayl, Marun ar Ras, and Markaba.[43] Presumably, maintaining Hezbollah control of each of these locations inhibited Israeli access to the Saluqi Valley, a natural approach route into Lebanon. Conversely, Hezbollah relied on guerilla tactics when Israelis entered, virtually unopposed, Rabb ath Thalathin on 30 July.[44]

**Organization.** Hezbollah focused its diverse organizational design beyond armed resistance and toward the many roles it fills as both a national political party and the agent responsible for regional and local governance.[45] Its continued success is due in large part to Hezbollah's creation of three functional roles within its organization: military, social, and political. Combined, these three roles provide a diverse organizational structure, instrumental to the continuous supply of much needed money, weapons, and people.[46] The diversity of Hezbollah's organization provides it with the means to continue with the harassment of Israel, which entices the Iranians to supply Hezbollah with money and weapons. Iran reportedly provided $25-50 million of economic aid along with extensive military support to Hezbollah during the Israeli-Hezbollah War in 2006.[47] Iranian military support included: approximately 10,000 short range, small Katyusha-type rockets along with their launchers; longer-range rockets capable of striking major Israeli cities, such as Haifa;[48] the Iranian Mohajer unmanned aerial vehicle (UAV), which provided two surveillance flights over northern Israel; and

[43] Anthony H. Cordesman, With George Sullivan, and William D. Sullivan. *Lessons of the 2006 Israeli-Hezbollah War* (Washington, DC: Center For Strategic & International Studies, 2007), 57.
[44] Cordesman, *Lessons of the 2006 Israeli-Hezbollah War*, 57.
[45] Kindt, "Hezbollah: A State Within a State," 243.
[46] Philippone, *Hezbollah*, 21.
[47] Cordesman, *Lessons of the 2006 Israeli-Hezbollah War*, 3.
[48] Cordesman, *Lessons of the 2006 Israeli-Hezbollah War*, 3.

the Iranian C-802, anti-ship missile, which was responsible for crippling an Israeli ship on 14 July 2006.[49]

The implementation of Hezbollah's armed jihad, i.e. their military role, is the responsibility of the party's military and security apparatus. There are two known, although clandestine, sub-organizations of Hezbollah's military and security apparatus: the Islamic Resistance and the Party Security.[50] The Islamic Resistance is responsible for recruiting fighters along with the Combat Section. The Combat Section provides training in martial arts, marksmanship, medical support, and weaponry. The Combat Section further breaks out into four organizations responsible for the execution of Hezbollah's military duties.[51] The hallmark characteristic of Hezbollah's military wing is each group within the wing is self-contained and semiautonomous.[52] These characteristics protect the integrity of the organization as a compromise in one branch will not expose the other branches to the enemy. The Party Security organization, on the other hand, is the party's most discreet and covert organization, responsible for internal security matters along with the security of society writ large.[53]

There are two types of fighters within Hezbollah's Combat Section: the elite or regular fighters, numbering about 1,000 men with advanced weapons and training, and the village fighters, whose numbers are difficult to estimate.[54] Although it is difficult to ascertain the precise use of each class of fighters, it would appear during Hezbollah's war with Israel in 2006, the elite fighters were centrally controlled and deliberately tasked in response to Israeli ground movements and in defense of strategically important objectives. Hezbollah likely organized the village fighters into small, self-sufficient teams capable of operating independently and without direction from high authority for long periods of time. Although this flattened organizational structure represented a departure from an exceedingly hierarchical structure more typical of Arab militaries,

[49] Cordesman, *Lessons of the 2006 Israeli-Hezbollah War*, 8.
[50] Hamzeh, *In The Path Of Hizbullah*, 70.
[51] Hamzeh, *In The Path Of Hizbullah*, 71.
[52] Hamzeh, *In The Path Of Hizbullah, 71*.
[53] Hamzeh, *In The Path Of Hizbullah*, 72.
[54] Cordesman, *Lessons of the 2006 Israeli-Hezbollah War*, 80.

Hezbollah's looser structure, according to Anthony Cordesman, may have worked to its distinct advantage during the 2006 war.[55]

Hezbollah's successful integration into the Lebanese political system is indicative of the strengthening of their political influence in the Middle East. Hezbollah's political efforts have earned the Shiite community in Lebanon an estimated $100 million a year in financial support from Iran.[56] Hezbollah's distribution of Iran's financial support, primarily in the poor suburbs of Beirut, has won the respect and appreciation of both the Lebanese and Shiite communities in southern Lebanon. As a result of Hezbollah's track record of efficient governance in southern Lebanon, the Lebanese and Shiite communities in southern Lebanon are dependent on Hezbollah's continued presence and influence in the region.[57]

Hezbollah's representation in Lebanon's parliament is evidence of their growing political influence in the region. In 1992, the Lebanese elected Hezbollah party members into twelve parliamentary seats (eight party members and four non-Shiite supporters) out of a 128-member parliament. In 1996 Hezbollah went on to win ten seats (seven party members and three supporters). Two years after that, the party participated in the first municipal elections held in Lebanon in 35 years, winning almost half of all municipal council seats in the south, the overwhelming majority of seats in the Baqa, and all of the seats for the Shiite districts of the southern suburbs of Beirut.[58] In 2000, Hezbollah's presence in parliament nearly doubled, occupying twenty-three seats in the Lebanese parliament.[59]

Hezbollah's involvement in the Lebanese political system is simply another means for them to achieve their organization's overall purpose. Amal Saad-Ghorayeb argues in *Hizbu'llah: Politics and Religion* Hezbollah was motivated to participate in Lebanon's democratic system as a means to promote their commitment to their ideological principles, not as a genuine commitment to democracy.[60] Saad-Ghorayeb further postulates Hezbollah would institute Islamic rule if the overwhelming majority of

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[55] Cordesman, *Lessons of the 2006 Israeli-Hezbollah War*, 81.
[56] Kindt, "Hezbollah: A State Within a State ," 244.
[57] Norton, *Hezbollah*, 106.
[58] Saad-Ghorayeb, *Hizbu'llah*, 46.
[59] Norton, *Hezbollah*, 98-102.
[60] Saad-Ghorayeb, *Hizbu'llah*, 55.

Lebanese people demanded the establishment of an Islamic state. The implication is Hezbollah would overturn the democratic system that brought it to power if it obtained a parliamentary majority.[61]

Interestingly, many of the democratic principles Hezbollah supports as a member of the Lebanese parliament are in direct contrast with the party's ideology. For example, Hezbollah's vision of a pure Islamic state prohibits the participation of a non-Islamic party from its political system, unlike Lebanon's politically pluralistic parliament.[62] More specifically, Hezbollah's pure Islamic state does not tolerate participation of non-Shiite religious parties in its pure Islamic state. In fact, Husayn al-Mussawi, a prominent member of Hezbollah's Shura Council, made it known "non-Muslims would not be part of [Hezbollah's vision of a pure Islamic] government."[63] Therefore, not only is Hezbollah's ideal government void of non-Muslims, but it is also void of non-Shiite Muslims. The significance of this restrained approach is Hezbollah's use of politics is one of several means to create an Islamic state of the Middle East centralized under the *Wilayat al-Faqih,* the Council of Guardians, and ultimately, under God. To accomplish this goal, Hezbollah recognizes they must be willing to operate within Lebanon's current political environment until the day the population chooses to replace it. When that happens, Hezbollah will "strive to regain people's trust, so that it could reinstate its government democratically and not through revolution."[64]

Socially, Hezbollah possesses many of the same traits as expected of a responsible local governmental organization. Hezbollah's social programs offset effectively Lebanon's failed social services by creating an extensive social infrastructure which includes construction companies, schools, hospitals, dispensaries, and micro-finance initiatives.[65] Additionally, Hezbollah's array of social services included financial initiatives offer their constituents approximately 750 small loans each month.[66]

Hezbollah's Social Unit, a sub-organization of the Executive Council, provides social welfare services as well as technical help to thousands of Hezbollah members and

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[61] Saad-Ghorayeb, *Hizbu'llah*, 57.
[62] Saad-Ghorayeb, *Hizbu'llah*, 48.
[63] Saad-Ghorayeb, *Hizbu'llah*, 45.
[64] Saad-Ghorayeb, *Hizbu'llah*, 57.
[65] Norton, *Hezbollah*, 109.
[66] Norton, *Hezbollah*, 109.

supporters and to the families of martyrs.[67] Since 1988, the Social Unit has constructed eleven schools, three homes, and 44 mosques. During the same period, the Social Unit also rehabilitated 24 schools, 9,640 homes, and 56 mosques. In total, the Social Unit built and rehabilitated well over 10,000 schools, homes, shops, hospitals, and mosques.[68] Furthermore, the same organization provided medical care, health services, social services, and educational services to over 11,000 of its wounded warriors between 1990 and 2001.[69]

Despite devastating attacks against Hezbollah's services framework by Israel in 2006, the party was able to respond to the rising needs of its constituents. In an interview conducted by National Public Radio (NPR) immediately following the UN brokered ceasefire of their 2006 war with Israel, a Hezbollah spokesman promised to provide housing and furniture for the next year to each of the tens of thousands of families whose homes were destroyed by the month-long Israeli bombing campaign.[70] These public outreach programs have ensured Hezbollah retains its Shiite supporters, both within Lebanon and throughout the region.

**Characteristics of Hezbollah as a System**

Nearly three decades ago Hezbollah emerged as a Shiite militia determined to evict Israel from Lebanon. Their growth has taken them from a localized terrorist organization into a political organization with regional influence. In 2006, Israel's major military attack on Hezbollah's strong-holds in Southern Lebanon both failed to secure the return of their kidnapped soldiers or to destroy Hezbollah's presence in Lebanon. Instead, following a 34-day war, Hezbollah emerged stronger than before having survived a full-frontal assault by their militarily superior neighbor and eternal enemy. Hezbollah has proven itself to be a highly survivable organization. As a highly survivable complex adaptive system, the characteristics of Hezbollah's purpose, leadership, and organization provides insight for the military strategist and planner about those characteristics which improve a system's resiliency and ability to survive despite operating in a hostile environment.

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[67] Hamzeh, *In The Path Of Hizbullah*, 49.
[68] Hamzeh, *In The Path Of Hizbullah*, 50-51.
[69] Hamzeh, *In The Path Of Hizbullah*, 53.
[70] Nahim Sueydan, interview by Ivan Watson, 17 August 2006, transcript, National Public Radio, http://www.npr.org/templates/transcript/transcript.php?storyid=5662485 (accessed 7 February 2009).

Hezbollah's clearly defined purpose effectively unified their entire organization towards a common goal. Hezbollah's "Open Letter' clearly defined Hezbollah's central purpose: to create a pure Islamic government within the Middle East. The clarity of Hezbollah's purpose ensures their members and supporters understand precisely the reason for the system's existence. This allows members and supporters to make an informed decision whether they join and/or support the organization. Clarity in Hezbollah's purpose avoids ambiguity, which, in turn, avoids confusion and dissent. Ambiguity in an organization's purpose will likely lead to a weakened system as the parts struggle to unify their efforts according to their interpretation of the organization's purpose.

Hezbollah effectively communicates their central vision throughout their entire organization. Hezbollah's elaborate vertical and horizontal communication network is instrumental in ensuring Hezbollah's central purpose is available to every member at every level of its organization. Additionally, the use of the television, radio, print, and the internet permits Hezbollah to spread their ideological seed, which serves as a means to attract future members and supporters. As a consequence, Hezbollah has become a well-known organization regionally and globally. The advantage of becoming a well-known organization with a clear purpose is unincorporated communities are aware of a viable alternative organization should they become disenchanted with their current government. Therefore, Hezbollah's communication network enables the effective interconnection of the organization's leadership with all of the parts of the organization.

Another characteristic of Hezbollah's unified purpose is it has remained unchanged since Hezbollah first published the "open letter" in 1985. This provides Hezbollah's many organizations a stable and consistent vision for current and future operations. The most significant advantage gained with a stable and consistent purpose is the many parts within Hezbollah's organization are able to develop long-term strategies to support the system's strategic vision. As a result, Hezbollah was able to enter long-term relationships with its supporters, to develop long-term political strategies, make long-term financial investments, and even invest in long-term technological developments. Although the ways and means may change over time, Hezbollah's

unchanging vision provides their organization with the internal stability required of an organization with a long-term strategy.

Hezbollah's leadership philosophy values the interdependent and collective efforts of many rather than relying on a single individual. Although Hezbollah's secretary general possesses unquestionable authority over the organization, his delegation of leadership roles and decisions throughout the organization empowers subordinate commanders and creates a degree of autonomy within the organization. Additionally, Hezbollah's members elect the leaders of the Central Council through a democratic election process, providing a representative governing body for the organization. The leadership of those elected to the Central Council in turn becomes the leadership of the other councils, to include the Shura Council. This is significant as the decisions and grand strategy for Hezbollah come from a council of respected and representative leaders within the organization.

In order to integrate the great many functions within the organization, Hezbollah has created an effective decision making principle embracing the tenet of both centralized and delegated decision making. Consequently, Hezbollah is able to control centrally the many parts of their organization, making it possible for Hezbollah to profit through unity of effort and mitigate conflicting actions within the organization. In effect, Hezbollah's centralized control and decentralized execution coordinates the efforts of the organization while also providing the various parts the opportunity to create and capitalize on emergent opportunities.

Organizationally, Hezbollah's diverse organizational structure provides them with a wide variety of methods to achieve their overall purpose, thereby reducing the risk of failure to the organization. Hezbollah's interrelated use of politics, social programs, and military forces is essentially a hedge strategy to minimize their exposure by creating redundancy within their organization. Although Hezbollah potentially weakens their return by not placing their entire effort into a single strategy, in the end this approach strengthens the organization's survivability by ensuring its continued survival should a single strategy fail.

Hezbollah's philosophy regarding delegated decision complements their flattened organizational structure. The horizontal nature of their organization removes many of the

intervening management levels within typical organizations, which significantly improves the exchange of information, allowing the members to interact directly with the leadership and decision makers. In effect, the horizontal structure allows the members of the organization to participate directly in decision making. This interaction between leaders and members allows for the rapid exchange of information, management of feedback, and the ability for Hezbollah's leadership to maintain an awareness of its surroundings. These qualities allow the organization to respond rapidly to changes in its environment.

Ultimately, viewing Hezbollah's purpose, leadership, and organization provides insight into those characteristics of a complex adaptive system that enhance its resiliency and survivability in a hostile and rapidly changing environment. In contrast, the next chapter assesses the failure of the German military-industrial complex during WWII.

## Chapter 3
## Germany's Goliath:
## The Fall of a Military-Industrial Giant

Germany began WWII as one of the most technologically sophisticated nations in the world. Germany pioneered the use of wind tunnels, jet aircraft, pusher propellers, metal aircraft, and rockets in the build up to WWII.[1] German engineers became the world's leading technological innovators, working on projects including the all-wing aircraft, the tailless airplane, radars, radios, aircraft navigation, encrypted communications, and even rocket-propelled aircraft.[2] Yet over a few short years, German technological innovation stagnated, enabling the Allies to close the gap. German technological innovation in the build up to WWII was second to none, yet the German Technical Office, trusted to the task of continuing technological innovation during WWII, failed to maintain the momentum. An interesting and revealing example of German skills was the Allies' covert purchase of large quantities of glass eyes manufactured in Germany for wounded Allied servicemen during the war.[3] Despite their pre-WWII success, German technological innovations eventually failed, offering an opportunity to evaluate the key characteristics of a complex adaptive system lacking the required resiliency to ensure its survival in a hostile and rapidly changing environment.

### Historical Background

Prior to WWII, Germany's aircraft industry enjoyed a strong technical and intellectual foundation, led by the world-class Aeronautical Research Institute at the University of Gottingen. During the 1920s and 1930s, German technical innovations included revolutionary designs, such as the swept-back wing. This innovation alone increased aircraft speed and endurance with current power plant technologies by drastically reducing the drag on the aircraft. Later, engineers discovered a problem with slow speed handling characteristics of the swept-wing, and in searching for a solution

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[1] Maj Chares A. Pryor III, "From First to 'Wurst:' The Erosion and Implosion of German Technology in WWII," in *Old Lessons New Thoughts: Readings in Logistics, History, and Technology 2006,* ed. James C. Rainey, et al. (Maxwell AFB, AL: Air Force Logistics Management Agency, 2006), 67.
[2] James S. Corum, *The Luftwaffe: Creating the Operational Air War, 1918-1940* (Lawrence, Kansas: University Press of Kansas, 1997), 113.
[3] Tom Bower, *The Paperclip Conspiracy: The Hunt for the Nazi Scientists* (Boston, MA: Little, Brown and Company, 1987), 5.

developed many of the aircraft designs used today—nearly 80 years later. Discoveries such as crescent wings, delta wings, variable-sweep wings, leading-edge flaps, and boundary layer control, are all examples of German innovations found on today's high performance aircraft.[4]

By 1937, Germany had introduced four revolutionary military aircraft: the Bf 109 fighter, the He 111 bomber, the Do 17 bomber, and a few Ju 87 dive bombers.[5] The Bf 109 instantly established its dominance in the air over Spain, where it outperformed the menacing Soviet I-15 and I-16 fighters with ease. Additionally, the superior speed of the German He 111 made it possible for the bomber to evade most interceptors, introducing the world to unescorted daylight raids, providing a glimpse of the grim future for towns like Dresden, Tokyo, and Hiroshima.[6] The Germans' initial design for the Do 17, the "Flying Pencil," was as a commercial airliner, but later they adopted it as a high-speed bomber. The Do 17 provided the means for Germany to prove itself successful in bombing and reconnaissance roles during operational testing in Spain in the summer of 1937.[7] Finally, the Ju 87 became a leading dive bomber following its outstanding performance in Teruel, also in Spain during the spring of 1937. The improved performance of the Ju 87Bs, along with their increased armament, better bomb load, and high-pitched siren, gave the Ju 87 its dreaded reputation during the first phase of the Second World War.[8] German technological innovation during the interwar years resulted in a modern and powerful air force which proved instrumental in their rapid defeat of Poland in 1939.

In addition to major technological innovation in aviation, the Germans also proved adept in other technical fields. Specifically, German technological innovations in electronic warfare surprised the British during the 1940 Battle of Brittan. Following the recovery of a crashed He 111 in March 1940, the Royal Air Force learned of Germany's further development of the Lorenz Company's navigation radio beam designed to help

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[4] Ingolf Meyer and Walter Schick, *Luftwaffe Secret Projects: Fighters 1939-1945* (London: Midland Publishing Limited, 1997), 7.
[5] Williamson Murray, *Strategy for Defeat the Luftwaffe 1933-1945* (Maxwell AFB, AL: Air University Press, 2004), 15.
[6] John Killen, *A History of the Luftwaffe* (Garden City, NY: Doubleday & Company, Inc, 1967), 73-73.
[7] Killen, *A History of the Luftwaffe*, 71.
[8] Killen, *A History of the Luftwaffe*, 72.

aircraft locate airfields in bad weather. Unexpectedly, Germany's Dr Hans Plendl, a specialist in radio-wave propagation, adapted the Lorenz system to assist in aircraft navigation during the night and in bad weather.[9] Plendl's modified Lorenz system became the *X-Gerät*, which employed six Lorenz-type beams to mark the desired ingress route and final bombing run-in to a target. German advances in radar technology also surprised the British. The Freya radar provided the Germans with early warning indications of inbound aerial attacks out to seventy-five miles, and a rotating aerial array giving 360-degrees of coverage.[10] The Freya radar system proved its worth on 18 December 1939 against twenty-four British Wellingtons on patrol for German warships. The Freya radar detected the approaching Wellingtons, alerting sixteen Bf 110s and thirty-four Bf 109s alert fighters of the inbound raid. Aided by the Freya radar, the alert fighters quickly located and destroyed twelve of the twenty-four British bombers.[11] In this single event, the Royal Air Force developed an appreciation for Germany's technological innovations in electronic warfare.

In the early 1920s, Germany produced another innovation which offered a technological solution to those problems facing German cryptographers during WWI--the Enigma. During WWI, the transmission of secret messages within the German government and military required cryptographers to code and decode messages with codebooks that were nearly impossible to protect against physical compromise. Following WWI, the Enigma provided a portable means to transmit message traffic via a secure and easy-to-use machine. Although extremely simple to use, the Enigma offered the Wehrmacht an almost inconceivable theoretical number of possible letter substitutions; $3x10^{114}$ possible variations.[12] Ray Miller, of the US National Security Agency, put this number into perspective when he noted, "[t]o see just how large that number is, consider it is estimated there are only about $10^{80}$ atoms in the entire observable universe. No wonder the German cryptographers had confidence in their

[9] Alfred Price, *Instruments of Darkness: The History of Electronic Warfare, 1939-1945* (London: Greenhill Books, 2006), 23.
[10] Price, *Instruments of Darkness*, 52.
[11] Price, *Instruments of Darkness*, 53.
[12] R. A. Ratcliff, *Delusions of Intelligence: Enigma, Ultra, and the End of Secure Ciphers* (New York: Cambridge University Press, 2006), 18.

machine!"[13] Technologically speaking, Germany's Enigma encryption system offered the Germans a distinctive advantage over the Allies.[14] However, Germany failed to capitalize on this position of advantage, and instead the Enigma machine became an embarrassment to the Germans when in 1974, after decades of secrecy, the British government finally admitted its WWII intelligence service had read hundreds of thousands of German messages encrypted by Enigma.[15]

**German Technological Innovation in Action**

Early in WWII, Germany dominated the European continent by militarily defeating Poland, Norway, France, Belgium, Holland, Yugoslavia, Denmark, and Greece. Germany's early successes were due in large part to its technological superiority over its adversaries. A change occurred, however, following the Battle of Britain, when Germany's bombing campaign failed to destroy Britain's air defenses and knock Britain out of the war.

Stovepiped organizations along with compartmentalization within German industry stifled attempts to develop technologies relevant to their war efforts. For example, the Me262 suffered significant production delays due to developmental issues associated with its power plant. Germany developed the first mass produced turbojet engine in the world, the Jumo 004, to power the new jet fighter; however, the engine was grossly under-designed with an average running life of only ten hours, restricting the jet's serviceability due to the need for frequent engine changes.[16] Unaware of the engineers' technical problems with the engine, the Technical Office continued with the development of the airframe, placing a heavy burden on German industry and production facilities throughout the country.

Germany's struggle to innovate technologically during WWII was not limited to aviation developments. The Enigma encryption device provided the Germans with an unprecedented wireless communications capability, facilitating secure communication both vertically and horizontally throughout the government and military. However,

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[13] A. Ray Miller, "The Cyrptographic Mathematics of ENIGMA" (NSA Pamphlet: Center for Crypologic History, 2001), http://ed-theen.org/comp-hist/NSA-Comb.htm (accessed 2 April 2009).
[14] David Kahn, "The ULTRA Conference," in *The German ENGIMA Cipher Machine: Beginnings, Success, and Ultimate Failure*, ed. Brian J. Winkel et al. (Boston MA: Artech House, 2005), 38.
[15] Ratcliff, *Delusions of Intelligence*, I.
[16] Alfred Price, *The Last Year of the Luftwaffe May 1944 to May 1945* (Osceola, WI: Motorbooks International Publishers & Wholesalers, 1991), 175.

problems within Germany's organizational structure prevented the elevation of concerns among many cryptographic branches regarding the security of the Enigma. The result was a justified loss in confidence in the Enigma system among users while German leadership chose to ignore indicators their ultra-secure communication system was no longer secure. The Director-General of Signals for the Luftwaffe, for example, had at one point refused to use the radio to send operational orders because he so distrusted Enigma's security.[17] The problem was threats of censorship and suspicion of dissent often pitted the Nazi Party against the military; the result was the blind acceptance of the status quo, resulting in the continued use of the Enigma. To make matters worse, German leadership ignored other technological innovations, such as Britain's Typex mechanical decryption machine, which suggested the Enigma technology was no longer in a league of its own. Instead, German leaders retained their confidence the Enigma was statistically impossible to decode in a timely manner with its revolutionary five-rotor design. Consequently, German experts, having neither the resources nor the inclination to develop the next wave of cyrptologic machines, allowed their technological progress in signals intelligence and cryptology to stagnate and eventually collapse during WWII.[18]

**Analysis of German Technological Innovation as a System**

**Purpose.** Nazism, or National Socialism, became the dominant ideology in post-WWI Germany. Frustrated by the Treaty of Versailles, Germany desperately sought the means to regain its national prestige. Adolf Hitler's extreme ideology united the war-torn Germans on a platform which touted a centralized government and the reinstatement of German pride. According to Hitler, "Germany will be either a world power or will not be at all."[19] The Nazi Party surprised itself when it captured one hundred and seven seats in the Reichstag in the national election in September 1930, turning it from the ninth and smallest party in parliament to the second largest. Adolf Hitler crystallized his vision of an invigorated fatherland by promising to turn it into a successor to the Holy Roman and Hohenzollern empires. It would last a thousand years, he swore, and Hitler would call it the Third Reich.

[17] Ratcliff, *Delusions of Intelligence*, 221.
[18] Ratcliff, *Delusions of Intelligence*, 213.
[19] Adolf Hitler, *Mein Kampf* (Boston, MA: Houghton Mifflin, 1939), 950.

Hitler presented his political views on the creation of a Pan-Germanic state in *Mein Kampf*. Hitler's theme throughout *Mein Kampf* was history is a struggle between the inferior and superior races of the world. Hitler's fear was the inferior races possessed a natural numerical advantage over the superior races, and absence of deliberate intervention by the superior races would result in the "lowering of the standard of the higher race."[20] Further expounding on his view of world races, Hitler attributed the root cause of the German collapse to their failure to recognize the race problem caused by Jewish influence.[21] In order to strengthen the "superior races," Hitler sought to regain control of Germany's pre-WWI resources and territory. This required Germany to "terminate the endless German drive to the south and west of Europe, and [according to Hitler] direct our gaze towards the lands in the east."[22] Specifically, Hitler focused his attention squarely on Russia and "its vassal border states."[23] It was this political objective that became Germany's unifying purpose guiding its preparation and strategy for executing WWII.

Adolf Hitler's "Drang nach Osten" ("Drive to the East") policy unified German efforts to build up militarily in preparation for what was to become WWII.[24] This required German military, industry, and economy to prepare for a short-duration, high-intensity, offensively-oriented military conflict against adversaries in Eastern Europe. In fact, this short-duration, high-intensity, offensive military tactic became the foundation for German Blitzkrieg doctrine. Enabled by technological advances such as the tank and airplane, German Blitzkrieg doctrine sought to avoid the stagnant trench warfare experienced in WWI by rapidly penetrating through the adversary's front lines. Blitzkrieg doctrine was the brainchild of Captain Heinz Guderian, a staff officer of the *Truppenamt,* in the Inspectorate of Transport Troops. Guderian's exhaustive readings of Giulio Douhet, Basil Liddell Hart, and J.F.C. Fuller informed his vision of the Blitzkrieg

[20] Hitler, *Mein Kampf*, 391.
[21] Hitler, *Mein Kampf*, 451.
[22] Hitler, *Mein Kampf*, 950.
[23] Hitler, *Mein Kampf*, 951.
[24] Encyclopedia Britannica, "Drang nach Osten," Encyclopedia Britannica Online, http://www.britannica.com/EBchecked/topic/171039/Drang-nach-Osten (accessed 2 April 2009).

military tactic.[25] The first recorded illustration of the term Blitzkrieg came from Guderian's scheme he termed the "flash of lightning:"

> "One night the doors of [airplane] hangers and army garages will be flung back, motors will be tuned up, and squadrons will swing into movement. The first sudden blow may capture important industrial and raw material districts or destroy them by air attack so they can take no part in war production. Enemy governmental and military [centers] may be crippled and his transport system disorganized. In any case, the first strategic surprise attack will penetrate more or less deep into enemy territory according to the distances to be covered and the amount of resistance met with."[26]

Consequently, Guderian's Blitzkrieg military doctrine provided German industry with a common vision and purpose—the development of technologies to support the Blitzkrieg concept of operation. Germany's initial success in 1939 and 1940 demonstrated Germany had successfully prepared for their rapid eastward expansion.

The problem, however, was Hitler's initial successes encouraged him to shift away from his original objectives and expand rapidly his area of operations. Following Hitler's rapid successes in Eastern Europe, he shifted Germany's attention to the north, against Great Britain, the west, against France, and the south, against various countries in the Mediterranean. Williamson Murray, in *Strategy for Defeat,The Luftwaffe 1933-1945*, wrote Germany's subsequent decision to expand their efforts beyond recapturing lost territory and resources in the east outpaced their military, industrial, and nation's capacity, making their defeat inevitable in the early years of WWII.[27] The expansion of the war to surrounding territories created three problems for the German technological development in support of Blitzkrieg doctrine: (1) the three front war spread the German forces thin, thereby weakening their force strength on subsequent attacks; (2) attrition rates in the Battle of Britain and in the skies over the Africa Corps diminished rapidly one of the key tools in the Blitzkrieg—the airplane; and (3) the cumulative effect was to lengthen the war well-beyond the originally envisioned short duration for which Germany designed its technologies. Furthermore, as the overall purpose of the war expanded from Eastern Europe to the surrounding territories, guidance to those agencies

[25] Charles Messenger, *The Art of Blitzkrieg*, (Runnymede, England: Ian Allan Ltd, 1991), 81.
[26] Messenger, *The Art of Blitzkrieg*, 81.
[27] Murray, *Strategy for Defeat the Luftwaffe 1933-1945*, Chapter VIII.

responsible for continued technological innovation during the war remained focused on the short-term, high-intensity, Blitzkrieg doctrine.

Early in the war, German leadership derailed Germany's technological innovative potential through a series of directives called for the stoppage of technological development throughout the Wehrmacht. The first directive originated from the Chief of the German Technical Office, Ernst Udet, and limited German technological innovations in the Luftwaffe. On 7 February 1940, Udet sent a letter to the Luftwaffe Commander in Chief setting forth his priority for the production of "only those aircraft models [that] are in active use at the front."[28] Two days later, Hermann Goering (presumably functioning as chairman of the Ministers' Council for the Defense of the Reich) held a meeting where he expanded Udet's guidance to limit the production of all armament equipment to "[t]hose projects slated for completion in 1940 or 1941."[29] In the fall of 1941, Germany's leadership cadre joined the Luftwaffe with an initiative to restrict further the development of future technologies by requiring all procurement and development requests receive approval from the Chief, Wehrmacht High Command. Furthermore, in response to Hitler's guidance in September 1941, Wilhelm Keitel, the Chief, Wehrmacht High Command, published an order curtailing all nonessential projects by directing "[t]he Chief, Wehrmacht High Command, will be responsible for evaluating each request."[30]

Despite Harold Faber's conclusion in *Luftwaffe: A History* that none of the German leadership's directives specifically called for a stoppage of developments, evidence suggests the centralization of procurement and development decisions created by these directives did in effect retard further German technological innovations. For

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[28] Harold Faber, ed., *Luftwaffe: A History*, (New York, NY: Quadrangle/The New York Times Book Company, Inc., 1977), 173.
[29] Faber, *Luftwaffe: A History*, 174.
[30]Werner Baumbach, *The Life and Death of the Luftwaffe*, trans. Robert Hale (New York, NY: Balantine Books, Inc., 1960), 36; "Fuhrer Order of 11 September 1941: The armament industry is overburdened with requisitions and the fulfillment of the program I have aid down is possible only if the demands of the services are harmonized and adapted to its capacity. The program I have laid down therefore calls for the following measures: 1) the requisitions of each of the services must be strictly limited to their essential requirements; 2) the OKW must decide priorities when the requisitions do not comply with the conditions set out above; 3) the most careful examination of the requirements of the services having regard to the capacity of the industry. To make certain that these measures are carried out I therefore order that requisitions by the services should not be sent to the productions departments except through the head of the OKW. The latter will discuss with the Minister of Armaments and Munitions the possibility of the armament industry's meeting them and he will, under my authority, decide the nature and scale of the orders to be passed." (Signed) Adolf Hitler. Faber, *Luftwaffe*, 174.

example, Hitler's intervention in the development of the Me262, the world's first jet fighter, delayed significantly the introduction of a potentially dominant air asset at a time the German Luftwaffe was struggling the most. Operating against the advice of the head of German aircraft production, Erhard Milch, and the commander of Germany's fighter force, Adolf Galland, Hitler ordered the Me262 changed from a pure fighter to a dual-role fighter/bomber. Furthermore, indecision and requests for configuration changes delayed the development of the Me262 until in 1944 the need for fighters had again surpassed the need for bombers, warranting yet another change. Hitler intervened, once again, in the development of the aircraft by directing the re-retrofitting of the aircraft back into a pure fighter role. Although Messershmitt had drawn up the plans for the Me262 in the spring 1939 and the aircraft first flew in the spring 1943, changes to its configuration delayed its introduction into the war until late 1944, too late to be of any benefit in the Luftwaffe's attempt to regain air superiority over Germany.[31]

As Hitler's appetite for conquest grew during WWII his strategic goals demanded Germany adopt a sustainable and balanced strategy in place of the Blitzkrieg doctrine. Strategically, Germany transitioned into a campaign requiring sustained operations, balancing offensive and defensive capabilities. However, Germany's technological innovations at the operational level of war remained focused on the quick-hitting, offensively-oriented Blitzkrieg doctrine. Consequently, Germany's inconsistent guidance at the varying levels of war prevented the parts of the German system from operating towards a common purpose.

**Leadership.** The burden for the development of technology in preparation for WWII fell to the German Luftwaffe. Germany's Blitzkrieg doctrine was the template guiding many of the technological innovations before and during WWII. Because the air war is the most technologically dependent of the military branches, according to James Corum, in *The Luftwaffe: Creating the Operational Air War, 1918-1940,* it became the responsibility of the air leaders to develop many of the technologies instrumental in Germany's war effort.[32] Therefore, leadership within the Luftwaffe exerted the greatest

[31] Baumbach, *The Life and Death of the Luftwaffe* ,Chapter XVI.
[32] Corum, *The Luftwaffe*, 170.

influence over technological innovations, and likewise, it was the Luftwaffe leadership that stood to suffer the most from technological failures.

Prior to Hitler's rejection of the Treaty of Versailles in 1935, General Walter Wever, who later became the Luftwaffe's first Chief of Staff, quietly created a large and technologically advanced German air force. Wever, in-turn, charged General Wilhelm Wimmer, head of the Technical Office and considered by many as "the best technical mind in the Luftwaffe," with the task of developing all new military technologies in preparation for WWII.[33] Under Wimmer's direction, the Technical Office oversaw the development of major projects such as the Me 109 fighter, the He 111, Do 17, Ju 86 bombers, and Ju 87 Stuka. During the Wever/Wimmer era, the German Luftwaffe led the world in many of the technologies required of a modern air force, and in the process created one of the strongest air forces the world had seen.[34]

Tragically for the Germans, Wever died in 1936 in an aircraft accident, and with his death so went the technological successes Germany had enjoyed to date. With Wever's passing, the Luftwaffe lost a commander who had the ability to provide the nurturing leadership in which the young military-industrial complex desperately required.[35] In the wake of Wever's death, Göring, the Chief of the Luftwaffe, appointed Lieutenant General Albert Kesselring as the Luftwaffe's new chief of staff. Although a competent leader, Kesselring lacked the diplomatic skills of his predecessor, creating tensions between Kesselring and Göring, and between Kesselring and Milch, then State Secretary of Aviation. The ensuing power struggle resulted in the marginalization of Kesselring as both Göring and Milch took on a more direct role in the day-to-day operations of the Luftwaffe, which began the unraveling of the strong leadership legacy of the Wever/Wimmer era and with it the German technological successes began to wither.

After Wever's death, Göring further upset the military-industrial complex by removing the competent Wimmer as the Chief of the Technical Office and replacing him with Ernst Udet, a rising star within the Luftwaffe. Udet, although a gifted flyer and a highly respected officer by his juniors, was under qualified to lead the German military-

[33] Corum, *The Luftwaffe*, 175.
[34] Corum, *The Luftwaffe*, 174.
[35] Corum, *The Luftwaffe*, 224.

industrial complex through the development and selection of future technologies.[36] Corum suggests the replacement of Wimmer with Udet was Göring's attempt to place a "yes-man" as the Chief of the Technical Office in order to give Göring more control over the organization.[37] Whatever Göring's motivations were, the removal of Wimmer following Wever's death marked a period of transformation in the leadership philosophies within of the German military-industrial complex. Making matters worse, Udet, unable to reconcile the conflict between his soldierly duty and the growing distrust among the leading men of the Luftwaffe, committed suicide in 1941.

Given the leadership challenges facing the German Technical Office, there was a strategic leadership void in the Technical Office. This void in leadership inhibited the Technical Office from recognizing and exploiting emergent opportunities in the early years of the war. The aircraft industry, relatively untouched by Allied bombing in 1940 and 1941, maintained the capacity to develop and manufacture new technologies needed by the front lines. For example, during this time, the German aircraft and aircraft engine factories managed to carry on their workload in relative freedom from many of disturbances plaguing the other industries. Additionally, the raw materials allocated to the Luftwaffe escaped detection and destruction by Allied air attacks, ensuring ample resources for the continued development of military technologies within the military-industrial complex.[38] Exploitable opportunities such as these went unrecognized as the German leadership was preoccupied with trivial struggles for internal power and control.

Adding to the dysfunctional relationship within the military-industrial complex was Hitler's propensity to create redundancy and discord between the various organizations.[39] Hitler created conflict between and within organizations to prevent any single individual or organization from gaining too much power. Redundancies within and between organizations also protected Hitler by avoiding the centralization of any one function or knowledge base in a single organization. Hitler sought to ensure every individual and every organization felt vulnerable and dispensable. While the conflict and strife this created within the various organizations ensured Hitler's preservation of power,

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[36] Baumbach, *The Life and Death of the Luftwaffe,13.* Corum, *The Luftwaffe*, 227.
[37] Corum, *The Luftwaffe*, 225.
[38] Faber, *Luftwaffe*, 172.
[39] Ratcliff, *Delusions of Intelligence*, 64.

it stifled innovation and development and was an instrumental reason behind Germany's failed military-industrial complex during WWII.

Hitler's involvement in technological developments only served to confuse an already difficult process as the Germans struggled to develop new technologies in response to the growing Allied air threat. Aggravated by Hitler's propensity to remove quickly any leader suspected of insubordination or incompetence, Hitler's centralized decision making regarding technological developments dramatically delayed the introduction of critical technologies and weapon systems. In addition to the previous delays to the Me 262 program, Hitler's involvement in the He 177 four-engine bomber resulted in extensive delays as he was unable to decide if the bomber should make its bombing runs from a dive or in level-flight.[40] Consequently, German engineers often delayed production in an attempt to accommodate the frequent developmental changes directed by Hitler. These delays dramatically inhibited innovation, squandering expensive parts, and wasted millions of man-hours. As if the starts and stops were not disruptive enough, Hitler's propensity to punish the bearers of bad news drove organizations, such as the Wehrmacht signals intelligence agency, to withhold critical information in an attempt to preserve their careers, and sometimes their lives.[41] Hitler's involvement in every decision regarding the military-industrial complex created an atmosphere where leaders were afraid to try anything new for fear of failure, and instead functioned only to serve the whims of Hitler rather than the demands of the war.

Ultimately, the leadership of the German military-industrial complex was inadequate, at best. Unanticipated personnel changes, internal power struggles, and over-centralization each contributed to the fall of Germany's Goliath—its military industrial complex.

**Organization.** Germany's leadership, from Hitler to Udet, preferred to centralize the control and decision making authority within the organizations responsible for the innovation of technologies during WWII. They also preferred to create massive, horizontal organizations. The problem, however, is the principle of centralized control is not compatible with a large, horizontal organization.

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[40] Baumbach, *The Life and Death of the Luftwaffe,43*.
[41] Ratcliff, *Delusions of Intelligence*, 220.

Udet's predecessor, Wimmer, logically structured the Technical Office horizontally by creating four departments: research, development, procurement, and internal administration and budget. Under Wimmer's leadership, the Technical Office's structure allowed each department to deal directly with challenges inherent in the development of aircraft and other technologies.[42] The advantage Wimmer realized by this decentralized organizational construct was each of the four department heads was able to hold a wide degree of decision making authority over their area of expertise. The coupling of delegated decision making with a horizontal organizational structure proved effective as the German technological industry flourished prior to WWII.

Following Wimmer's death, however, Udet redesigned the Technical Office into a mammoth organization, growing Wimmer's four departments into thirteen.[43] Furthermore, Udet controlled an additional nine departments and five testing stations associated with the Supply and Procurement Office. By 1940, Udet controlled an astounding 26 departments. Making matters worse, Udet refused to create a centralized administrative organization, general staff, or any sort of internal organization to aid him in the coordination and synchronization of the great many functions within the Technical Office. Udet placed every department on equal footing and centralized the control and decision making for the entire organization under his direct command. Consequently, this created an information bottleneck, forcing many department heads to wait for months to have the opportunity to see their chief.[44] Udet created a huge organization in which, according to the Luftwaffe's top legal officer General Freiherr von Hammerstein who investigated Udet's suicide, "[i]nternally everyone [in the Technical Office] was working against everyone else."[45] Udet centrally controlled his huge, horizontal organization, creating a stifling environment where technological innovations suffered.

The complications created by the mismatch between centralized decision making and a horizontal structure became even greater as the conflict between Milch and Kesselring shook the stability of the Technical Office. The organization of the Luftwaffe, prior to Milch and Kesselring's dispute in early 1938, put Milch, the State

[42] Faber, *Luftwaffe*, 62.
[43] Richard Suchenwirth, *Command and Leadership in the German Air Force*, USAF Historical Study 174 (Maxwell AFB, AL: USAF Historical Division, Air University, 1969), 71.
[44] Suchenwirth, *Command and Leadership in the German Air Force*, 72.
[45] Suchenwirth, *Command and Leadership in the German Air Force*, 72.

Secretary of Aviation, under Göring, the Commander in Chief of the Luftwaffe, and in direct command over the many organizations within the Luftwaffe to include both Kesselring's General Staff and Udet's Technical Office. The power struggle between Milch and Kesselring originated with Kesselring's desire to strip the State Secretary of every vestige of power. The resulting reorganization of the Luftwaffe at the top-level aligned the General Staff under Göring, and maintained the Technical Office under Milch, in effect splitting the customer, the General Staff, from the manufacturer, the Technical Office.

The reorganization of the Luftwaffe deprived Milch of much of his authority and divided the Luftwaffe into two parallel organizations that did not interact. Kesselring, as the Chief of the General Staff was responsible for the entire air operations staff which included the training, mobilization, armament, and execution of the Luftwaffe. Udet's Technical Office was responsible for the development of new technologies to meet Kesselring's demands. The reorganization effectively divorced the two organizations over what amounted to a personality conflict. Rather than stepping into the breach between Milch and Kesselring, Göring chose to permit the division, in part because of his fear of Milch's growing power and influence. This placed a tremendous burden on Göring as he faced the difficult task of becoming the single point of coordination between the two organizations.

Division within the Luftwaffe and Technical Office created the environment where unchecked developmental requirements prevented the timely and relevant introduction of new technologies. This was evident in requirements such as the Luftwaffe's General Staff request for all bombers to be able to deliver their weapons from a dive. The diving delivery requirement added an unnecessary technological demand creating developmental delays, preventing the Ju 88 and He 177 from becoming operational.[46] In connection with the increased airframe weight brought on by the diving requirements of the Ju 88, Dr Heinrich Koppenberg, member of the Board of Directors of the Junkers firm, complained of the "horrendous number of changes, some 25,000 in all," preventing the timely development of the Ju 88.[47] With regard to the He 177, the

[46] Faber, *Luftwaffe*, 65.
[47] Faber, *Luftwaffe*, 66.

Luftwaffe's General Staff set unrealistic requirements and placed untenable demands on its development, preventing its introduction during WWII. The Ju 88, on the other hand, although delayed by the General Staff's demands, eventually entered into service and proved to be very successful despite all of its troubles.

Although the divided organization had eroded Milch's influence within the Luftwaffe, costing Udet a critical pillar of support, Udet's suicide in late 1941 and with prompting by Hitler, Göring brought Milch back into the Technical Office as Udet's successor. Thanks to his experience as the previous director of the highly successful German national airline, Lufthansa, Milch gained the reputation as a far-sighted, tremendously energetic, and capable manager, from which the Technical Office stood to benefit.[48] Milch sprung into action and managed to bring aircraft production back into line, giving the aircraft industry new impetus. Under Udet, the monthly fighter production barely exceeded 400 in the spring 1941 and totaled only 2,992 fighter aircraft for the entire year. Under Milch, however, the aircraft industry produced 4,583 fighters in 1942, and in 1943, the aircraft industry produced 9,601 Fw 190s and Me 109s, along with 6,601 bombers.[49] Although the resurgence of aircraft production under Milch's guidance was impressive, it was too little, too late. Williamson Murray, in *Strategy for Defeat, The Luftwaffe 1933-1945*, argues convincingly Germany had already lost WWII by late summer of 1940.[50]

The largest critique of the Technical Office during WWII was the incompatibility of centralized decision making in a large horizontal organization. In essence, the Germans organized their technical organizations horizontally, but imposed a leadership philosophy more appropriate for a vertical organization. The amount of information generated by the Technical Office was too great for any single decision maker to control. Additionally, the divisions within organizations and the heavy burden of unrealistic requirements further prevented the Technical Office from keeping up with the technical demands of front line forces. In the end, Germany's organizational practices affected adversely its ability to innovate technologically during WWII.

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[48] Suchenwirth, *Command and Leadership in the German Air Force*, 18
[49] Suchenwirth, *Command and Leadership in the German Air Force*, 38.
[50] Murray, *Strategy for Defeat the Luftwaffe 1933-1945*, 302.

**Characteristics of German Technological Innovation as a System**

Prior to WWII, Germany was one of the world's most technologically advanced nations, having developed revolutionary technologies in the field of aviation, electronic warfare, and secure communications, to name a few. Then something changed. Germany failed to maintain their technological parity with the Allies, allowing the Allies to challenge Germany's supremacy in air and electronic warfare. In the end, German technological innovations during WWII were unable to adapt in response to the hostile and rapidly changing environment imposed on the Germans by the Allies. Therefore, evaluating the characteristics of the German military-industrial complex as a complex adaptive system provides insight into those traits of a system's purpose, leadership, and organization that reduce its resiliency and survivability.

Before WWII, Germany's clear and unifying purpose provided the focused for the development of new technologies. Specifically, Hitler's "Drive to the East" policy, coupled with their Blitzkrieg doctrine, provided technological innovators with a clear vision of future technological demands. As a consequence, Germany focused their developmental efforts on military technologies to support a short-duration, high-intensity, offensively-oriented military operation.

Hitler communicated effectively his vision for Germany's purpose through *Mein Kampf*, an autobiography mixed with political ideology. As the Nazi Party grew within German political circles, Hitler distributed free copies of *Mein Kampf* to marrying couples and to the families of military members fighting on the front. By 1933, Hitler had sold 240,000 copies of *Mein Kampf* and by the end of the war he had sold seven to eight million copies.[51] Hitler's use of *Mein Kampf* to distribute his political message, and what ultimately became the systemic purpose of Germany, spread by the German Propaganda Ministry. *Mein Kampf* strengthened Germany's resilience and survivability by focusing the many parts of the German system on the grueling task of preparing a nation for war.

Although Hitler communicated a clear purpose to all of Germany, he lost his focus by expanding the war to involve Great Britain, France, and eventually the US. This

[51] Spartacus Educational, "Mein Kampf," http://www.spartacus.schoolnet.co.uk/GERmein.htm (accessed 14 April 2009).

proved problematic as Hitler's change in Germany's overall purpose did not permeate down to lower level organizations. Strategically, Hitler's widening of the war shifted the emphasis away from the short-duration, high-intensity, offensively-oriented military strategy to one requiring more time and a balanced approach between offensive advance and homeland defense. As a result, the military-industrial complex remained focused on short-term victory while the German leadership pursued an entirely different strategy. Therefore, leaders at the strategic level of war and the operational level of war fought two different types of wars. In the end, the lack of a consistent purpose between Germany's organizational levels hindered German technological innovation and ultimately contributed to their defeat in 1945.

German philosophy on organizational leadership further constrained their ability to adapt to the challenges imposed by the hostile and rapidly changing environment of WWII. German leaders valued the centralization of control, decision making, and execution authority. Nowhere was this philosophy on leadership more evident than in those organizations responsible for the development and innovation of technology. The desire to centralize was due, in large part, to the paranoia felt by many German leaders, as well as the continuous competition between leaders for greater power and influence within the Nazi Party. The problem with a centralized approach to leadership and decision making, however, is it creates a bottleneck for the flow of information within a horizontal organization. This bottleneck of information prevents organizations from the free exchange of information, ideas, and lessons learned. Consequently, the many parts within the system often stagnate as they await guidance and direction from the single leader of the organization. Therefore, centralized control, decision making, and execution restricts the information processing capacity of a system, thus limiting the ability for a system to adapt quickly to changes in the systems environment.

This leadership philosophy was also evident in the manner in which German officials structured their organizations. Paranoia within the ranks of German leadership and a desire for power resulted in compartmentalized organizations to protect the status of leaders. In effect, compartmentalization mitigated most of the risk to leaders, like Hitler, Göring, or Udet, by preventing subordinates from gaining too much knowledge or power. Despite its weakness, a certain degree of compartmentalization may be necessary

in areas, such as technological development, to protect highly sensitive and classified systems and capabilities. The problem, however, is over compartmentalization prevents the horizontal exchange of information between the many organizations within the technological field. The horizontal exchange of information makes it possible for different organizations to benefit from the lessons learned by other organizations. Second, horizontal interconnectedness allows for the efficient use of time, money, and resources, through the deconfliction of duplicate efforts within the same organization.

Finally, German leadership's preference for horizontal organizations was incompatible with their preference for centralized decision making. Horizontal organizations require the delegation of decision making to allow subordinate leaders and managers to make rapid decisions in response to perceived changes in the environment. Absent of delegation, the requirement to collect information and funnel it to a single leader, inundated with information, is slow and contrary to the need for adaptability in a hostile and rapidly changing situation. The German weakness in their organizational design was it was not compatible with their leadership philosophy. Neither centralized decision making, nor horizontal organization alone prohibited the successful development of new technologies during the war. Instead, it was these two characteristics combined which brought German technological innovation from first to worst over the course of WWII.

There are several lessons to learn from an examination of German technological innovations during WWII. First, although Germany began WWII with a clear purpose, propagated through a major publication, its strategic goals grew dramatically during the war. However, German leaders failed to adjust accordingly the guidance at all levels of the system. Second, the incompatibility between a centralized decision making leadership philosophy and a horizontal organization created a situation where decision makers were inundated with information and unable to stay ahead of the system's demands. In short, the fall of the German Goliath was due in large part to these specific characteristics of its purpose, leadership, and organization.

## Conclusions

This thesis set out to identify the characteristics of a complex adaptive system that increase a system's resiliency and survivability. The impetus for this research is the growing concern throughout the Department of Defense regarding the military challenges a complex adaptive system presents. Military strategists require the means to make informed choices on how a military action will generate an adversary reaction. Rather than lumping all complex adaptive adversaries into the same unpredictable bundle, the DoD must develop descriptive qualifiers to anticipate the degree of resiliency and survivability of an adversary's system. Prior to qualifying a system, a better understanding of those characteristics that enhance a system's resiliency and survivability is necessary.

### Qualifying Complex Adaptive Systems

Several distinctive characteristics of highly complex adaptive systems emerged through the assessment of the purpose, leadership, and organization of Hezbollah during their war with Israel in 2006, and the German military-industrial complex during WWII.

A complex adaptive system improves its resiliency and survivability through a clearly communicated and consistent purpose. The first principle of war recognizes the importance of clarity in a system's purpose. According to joint doctrine, the first principle of war is the principle of objective, which is to direct every military operation toward a clearly defined, decisive, and achievable goal.[1] By defining a clear purpose, all parts of a system can focus their efforts toward an understandable and common end. Without it, a system is subject to the destructive influence of confusion and ambiguity.

In both case studies, Hezbollah and Germany possessed a clear strategic purpose. Hezbollah, in its 1985 "Open Letter" established clearly its strategic purpose: to promote the spread of a pure Islamic government within the Middle East. To accomplish its purpose, Hezbollah set out to eradicate the colonization of Westerners within Lebanon and destroy the state of Israel. Germany, frustrated by the Treaty of Versailles and its loss of territory and resources, sought to regain its national prestige. To rebuild the

[1] Department of Defense, *Joint Publication 3-0: Joint Operations* (Washington DC: Government Printing Office, 2006), A1.

German empire, Hitler's "Drive to the East" policy became the foundational concept to guide its war preparations and strategy. In both cases, a clear strategic purpose served to unify the system toward a common goal.

A system's ability to communicate a clear purpose to all of its parts ensures unity of effort, another principle of war. Unity of effort recognizes the value gained through the coordination and cooperation among all of the parts of a system toward a commonly recognized objective.[2] Hezbollah's use of the "Open Letter" and Al-Manar to communicate its purpose to its entire system proved very effective. In a similar vein, Hitler's effective use of *Mein Kampf* and his use of his political campaign to communicate his vision for Germany effectively disseminated his vision for Germany.

The consistency of a system's overall purpose does not imply a system's purpose cannot, or will not, change over time. Instead, success depends on a system's ability to reflect changes in its purpose throughout all parts and at the various levels of a system. In doing so, the parts of a system maintain a coherence with the overall purpose of the system, further enhancing the overall unity of effort. Since Hezbollah's public proclamation of its strategic goal in the "Open Letter," its purpose has remained unchanged. The unchanging nature of Hezbollah's purpose has ensured a consistent purpose throughout the entire organization.

Germany, on the other hand, changed its overall purpose during WWII. As Hitler expanded his military objectives during WWII he subsequently failed to communicate a new strategic purpose to Germany's military-industrial complex. As a result, Germany's military-industrial complex was supporting a war effort based on the limited objectives in Hitler's "Drive to the East" policy. In the meantime, Hitler was committing the German military to a far different war, requiring very different technological support.

In search of those characteristics of leadership that increase the resiliency and survivability of a complex adaptive system, evidence suggests the most successful systems delegate decisions to trusted subordinate leaders. Delegation of decisions fosters disciplined initiative, situational responsiveness, tactical flexibility, and reduced span of control. The last trait, span of control, is especially important as it allows subordinate commanders to exploit emergent opportunities by reducing the volume of information

[2] Department of Defense, *Joint Publication 3-0,* A2.

any one decision maker must process.[3] Further, delegation of decision making requires a sense of autonomy among the many parts of a system, providing the freedom for decision makers to respond immediately to changes in the system's environment. Instead of focusing on internal rules and controls as is common in centrally controlled systems, delegated leadership allows a system to channel its efforts and resources toward responding to externally induced challenges.[4]

Assessment of the leadership philosophies of Hezbollah and Germany offers contrasting perspectives of centralized and delegated decision making. Hezbollah's reliance on delegated decision making enhanced its adaptability and resiliency in its war with Israel. Hezbollah's leadership philosophy valued the interdependent and collective efforts of many rather than relying on a single individual. Paranoia within the German ranks, on the other hand, led to an exclusively centralized decision making leadership philosophy, resulting in the reduction of its adaptability. Germany's centralized leadership philosophy hampered the system's adaptability by reducing its information processing capability. Unable to process available information, German leaders were unable to adapt the military-industrial complex in response to the dynamic needs of the German military and the pressures imposed by the Allies.

Organizationally, horizontal organizations appear to provide a system with the greatest capacity to adapt to changes in their environment. This supports a critical requirement for systemic adaptations: the rapid exchange of information from the environment to the system's decision makers. Logically, the closer the decision maker is to the muscle, the faster a system will be able to respond to perceived changes in its environment. Horizontal organizations optimize the communication between the system's decision makers and the muscles by removing the middle-managers, characteristic of vertical organizations.

Hezbollah's flattened organization placed decision makers in close proximity to those elements of its system responsible for confronting the Israeli invasion. Its flattened organization, coupled with delegated leadership, allowed Hezbollah to process quickly available information and implement systemic changes, bolstering its resiliency.

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[3] Department of the Air Force, *Air Force Doctrine Document 1* (Maxwell AFB, AL: Air Force Doctrine Development and Education Center, 2003), 28.
[4] Gareth Morgan, *Images of Organization* (Thousand Oaks: Sage Publications, Inc, 2006), 111.

Germany's Technical Office, under Udet's leadership, also reduced the proximity of the decision makers to those agencies responsible for developing new technologies through a flattened structure. The issue with Germany's structure, however, was the incompatibility of a horizontal structure with a centralized leadership philosophy. While a reduction in the distance between a system's brains and its muscles improves its adaptability, the elimination of mid-level managers creates a huge span of control problem with a centralized leadership construct. Processing the volume of information generated by a system the magnitude of the German military-industrial complex is an untenable task for a single decision maker.

Assessment of a complex adaptive system's purpose, leadership, and organization offers valuable insight into those characteristics that make one system more resilient and survivable than another. The study of a successful system such as Hezbollah, and an unsuccessful system such as the German military-industrial complex in WWII, suggests the most resilient and survivable systems possess a clearly communicated and consistent purpose, a delegated leadership philosophy, and a flattened organization.

**Implications**

This thesis has identified several characteristics of a complex adaptive system that can aid military strategists and campaign planners in qualitatively measuring the resiliency and survivability of an adversary's system. By possessing a means to assess an adversary's system, the military strategist and campaign planner can anticipate its resiliency and survivability.

The overall assertion of this thesis is the more resilient and survivable an adversary system, the greater the amount of time, effort, and resources an opposing system requires in order to control or influence it. This is not to suggest it would take more time, effort, and resources to defeat Hezbollah than it did Nazi Germany. It does suggest, however, as a system's resiliency and survivability increases so too must the amount of time, effort, and resources devoted to the system attempting to control or influence it.

W. Ross Ashby, a founding father of cybernetics and systems theory in the 1950s, discovered a similar relationship between opposing systems in what he termed the law of requisite variety. The law of requisite variety, put into simple terms, states the variety of

a control system must be equal to or greater than the variety of the opposing system in order to achieve control.[5] Put into organizational terms, the ability for one organization to exert a controlling influence over another organization requires the controlling organization possess at least one degree of adaptability greater than the other organization. In other words, the degrees of freedom available to the controlling system must be greater than the degrees of freedom available to the controlled system. This introduces the notion of relativity in complexity and adaptability. Although devoting greater time, effort, and resources to a system increases a system's resiliency and survivability, more is not necessarily better. What is necessary is to devote only enough time, effort, and resources to a system so it is more adaptive than the system in which it must control. There must be a degree of efficiency when allotting time, effort, and resources in warfare, because these three commodities are always in short supply, and the strategist and planner must intelligently expend them only when and where necessary.

Being able to recognize the characteristics of a highly resilient system becomes exceptionally valuable to the strategist and planner, especially in the sequence of military operations. When confronting a highly resilient system, the strategist or planner must give the friendly system the resources to "run" the adversary system out of adaptations. This takes time. Therefore, tightly sequencing operations and basing decision points on a desired reaction of a highly resilient system will likely yield ambiguities and frustrations. Where possible, strategists and planners should provide ample time for the control of a highly resilient system and avoid linking time-sensitive decisions to a desired adversary reaction.

It is unproductive to continue to label categorically all adversary systems as complex and adaptive. This thesis set out to identify those characteristics of a complex adaptive system that makes one system more resilient and survivable than another. By assessing the characteristics of an adversary's system it is possible to anticipate and prepare for the resiliency of the adversary's system. Instead of retreating to the comforts of heuristics and firepower we must seek to demystify some of the mystic surrounding complex adaptive systems in war.

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[5] W. Ross Ashby, *An Introduction to Cybernetics* (London, England: Chapman & Hall, Ltd, 1957), 206-213

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