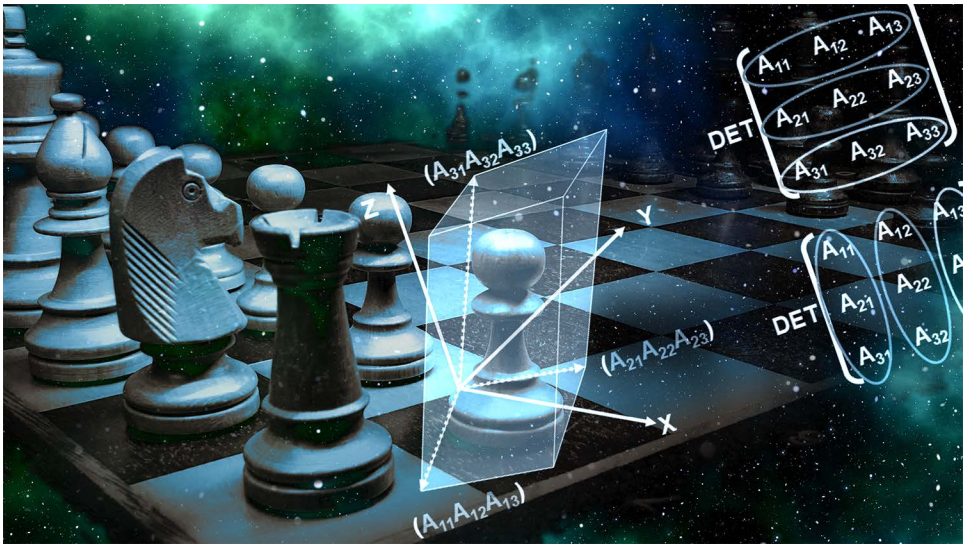
Media Interaction Warfare Theory

A Novel Analytic Process Supporting Space Warfare Planning Operations

Michael P. Scardera*
Dr. B. T. Cesul



Introduction

With the debate settled over whether space is a war-fighting domain and whether an independent space force should be established, the discussion now shifts toward providing analytic frameworks to answer more strategic questions about space warfare in general. Why do space forces matter? How do they integrate with war fighting in other domains? What is the "intellectual basis" for space superiority? What utility do space warfare capabilities bring to the joint military campaign, and at what levels are they necessary to achieve effects on the battle-

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field? These and many other questions have dogged the space community since the first militarily useful satellites were launched in the 1960s into the present. We describe a novel approach called the "media interaction theory of warfare," which provides a unique and simple way to evaluate different integrated force structures, offering a true joint forces perspective to begin addressing these questions while providing a basis for more analytic treatment.

Past military theorists were surveyed, providing a foundation for the premise behind media interaction warfare theory. From these past works, we construct a simple model containing interactions between different domain media. This construct leads to a media interaction matrix mathematical model based on linear algebra. This unique model development separates the analysis from previous work in the area. Based on an order of battle, an integrated force structure matrix can be built, and a determinant taken to provide a single value for the force structure's relative strength. This relative strength may, in turn, be compared to other very diverse force structures to find the dominating integrated armed force. The theory's implications and general ability to "unify" past military theories are briefly discussed. This media interaction warfare theory can validate or refute past ideas, and we focus on applying treatment to famous past airpower theory examples. We move on to illustrate an application to the joint air-sea-land battlespace with the World War II Guadalcanal campaign. Finally, we predict future applications with and without space warfare capabilities building a representative North Atlantic Treaty Organization (NATO)-Warsaw Pact conflict hypothetical scenario circa 1985.[1]

Past Military Theories of War: Background and Relevance

Reviewing famous military theorists' major works (fig. 1), they applied historical or rhetorical analysis in developing their ideas. Sun Tzu, Carl Von Clausewitz, Antoine-Henri Jomini, and B. H. Liddell Hart are among the best-known warfare theorists. Though these theorist's experiences and writings dealt with land warfare, many ideas, principles, and applications are generally applicable to all warfare media, whether on land, sea, air, or space. Sun Tzu pointed out the inherent differences between offense and defense. Meanwhile, Clausewitz discussed the asymmetry between offense and defense, elaborating with his "polarity" concept when applicable. Both Clausewitz and Jomini emphasized "geometric" principles. Liddell Hart emphasized indirect warfare, disrupting equilibrium, and combined arms operations warfare needs. However, these famous theorists generally did not consider how warfare might be affected by operations in media other than land. Understandably so, as their experiences were based on continental warfare, and the sea was not a significant player from their perspective.[2]

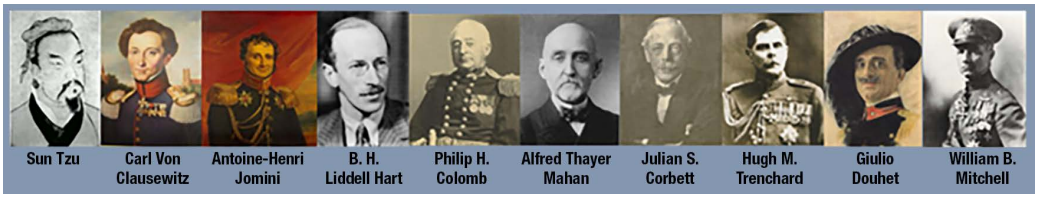

Figure 1. Famous military theorists based their ideas on experience, historical, and rhetorical analysis.

Sea power theory came into its own during the nineteenth century primarily through the works of Philip Colomb, Alfred Thayer Mahan, and Julian Corbett. "Command of the sea" is a common theme among these three theorists, though there are significant similarities and differences on what the theme meant and how command should be achieved. The sea power concept came to a powerfully heightened understanding during this era, maturing distinctly from military power with a significant effect on armed conflict. The first obvious principle states the sea is not a territory to be held like land, but a separate and distinct medium. Naval "lines of communications" was introduced by Colomb to address how sea control could be achieved. Mahan made an overwhelming argument sea control is essential for victory in warfare. Finally, Corbett made the sea power case encompass more than command of the sea but interactions with the land as well. Colomb was the first person to relate how interfaces between the land and the sea matter. He discussed how combined operations are superior to one force alone. Corbett echoed and expanded these ideas by pointing out the Army or Navy cannot win wars by themselves. Corbett also expanded Clausewitz's polarity concept to its necessary conclusion, defining offensive capability as a positive force and defense as an opposing negative force. Mahan expanded a strong case naval force's first objective is to defeat the enemy's naval force. Corbett takes a strategic naval view as one aspect of the entire war, where ultimately defeating the enemy's naval force may or may not be required to achieve sea control.[3]

Unlike land and naval power, airpower burst onto the scene in the early twentieth century, trying to justify itself as a real military capability relevant to the art of war. Airpower practitioners developed strategy, tactics, and operational art, while making the case air forces should rely on their professional corps. With airpower's global nature, overarching both land and sea, early airpower theorists presumed air control was a prerequisite to obtaining command of the sea or domination over the land. World War I provided an early incubator for airpower theories. Based on advocate observations, many theorists thought once air forces matured, they could win wars by airpower alone. Given the novel operations in the air medium, this idea was at least conceivable despite contradicting naval theorists' conclusions.

Hugh Trenchard, Giulio Douhet, and Billy Mitchell are the standout airpower theorists during this time. Trenchard was a tireless advocate who successfully created a separate air force in Great Britain during World War I. Like Mahan, he saw the Air Force's mission as the need to destroy the enemy's air forces. Similar to Corbett's sea power views, Trenchard saw air forces also applying to other missions.

Douhet is best known for his theories regarding offensive strategic bombing to be the sole air force purpose. His theories became very influential to all air forces before World War II. Generally, the offensive is paramount among all airpower advocates, whereas defense can be inherently found in the offensive. Both Trenchard and Mitchell had more multidimensional views about how airpower should support war fighting in total; they looked to bombing, interdiction, ground attack, observation, and supply as important roles to fulfill. Billy Mitchell gained fame in the US, conducting experiments to prove naval vessel vulnerability to airpower and notoriety when he was court-martialed for overzealous airpower advocacy. Clearly, airpower advocates saw air as its own war-fighting medium with dominating influences over the sea and the land media.[4]

Throughout the military theorists' history, there are many similarities and contradictions in their writings based upon the time, place, and experience upon which they have written and worked. General warfare principles have been developed and generally accepted. However, some common themes are represented briefly in table 1 that directly apply to formulating the media interaction hypothesis.

Major war theorists common themes	**Comments/examples**
Interactions within the media dominate	Army-Army contests dominate land warfare, Navy-Navy confrontation dominates naval warfare, and air-air combat dominates aerial warfare.
Each new medium has a dominating influence over the other media.	For the land warfare theorists, sea power was largely irrelevant and airpower largely unknown. Sea power theorists saw naval forces dominating the land once sea control has been gained and did not initially recognize airpower significance; airpower theorists believe air forces dominate both land and naval forces.
Interactions between media are important	Despite dominating influence applied to individual media, land in defending from seaborne attacks, sea into providing seaborne attacks at vulnerable locations, and air in attacking either the land or the sea. Combined operations are acknowledged as desirable.
New media greater mobility gives an initiative advantage.	Air forces are more mobile than sea forces, which are, in turn, more mobile than land forces. This mobility also provides an initiative advantage to the superior medium over the inferior medium.
Offense has a proactive aspect, while defense is retroactive.	General recognition offense and defense are different but can be described as opposing magnitudes as in a physical vector.
A geometric or mathematical construct is possible.	Many writers suggest a mathematical or geometric relationship could describe their ideas, but none are proposed.

Table 1. The commonality between land, naval, and airpower advocates and theorists presents applicable themes for a unified theory.

Media Interaction Warfare Theory Genesis

Figure 2 illustrates warfare evolution regarding land, sea, air, and space media, which portrays an obvious geometric growth in interactions. If a friendly and enemy side are considered for land warfare alone, there is only one interface or interaction. When sea power is included, possible interactions grow to four. Add airpower, and there are nine possible interactions. Finally, adding space forces creates 16 interactions.

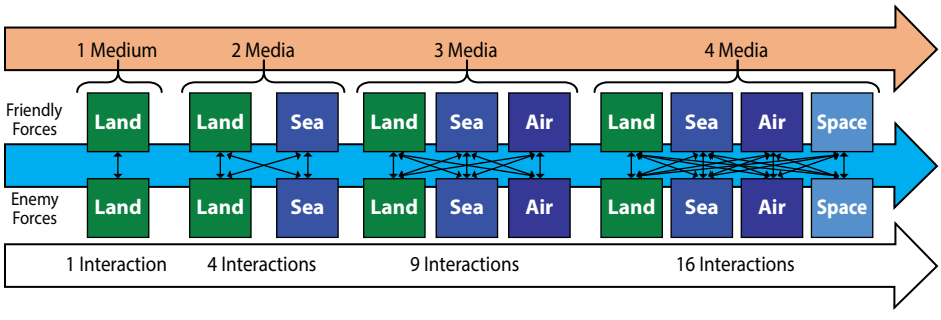

Figure 2. The number of interactions between opposing forces grows geometrically with additional media inclusion.

The progression shown in figure 2 clearly implies warfare complexity grows geometrically whenever a new medium is added to the mix. Looking at the interactions, the side dominating the greater number of interactions has a better chance winning a conflict. But looking at this construct with more scrutiny, one could surmise some interactions may be more dominant than other interactions. To make this construct useful, we need to convert this logical relationship into a useable mathematical construct. One simple idea models each individual interaction as a distinct entity. Applying this idea results in the matrix approach demonstrated in figure 3.

The first interaction modeled is land-to-land as a single block, the most important and fundamental baseline interaction. Controlling land and what occurs on land is the foundation for all warfare where everything ultimately begins and ends. Whatever other media is involved in warfare, the result always affects the people, economies, and other activities occurring on land. As civilizations evolved and the sea became important for commerce, naval power was born, and the interactions between the two media grew to four. When adding the sea medium, the sea-to-sea interaction is analogous to the land-to-land interaction. Additionally, we also include a sea-to-land offensive interaction and a land-to-sea defensive interaction.

Later, powered flight's invention introduced the third media, air, leading up to nine interactions in war. When adding the air medium, the air-to-air interaction is analogous to the land-to-land and sea-to-sea interactions. Expanding the ma-

trix previously constructed, air-to-sea and air-to-land offensive interactions, and a land-to-air and sea-to-air defensive interactions, fill in the interaction blocks to form a logical three by three matrix.

Long-range missile development and Sputnik's launch heralded a new medium for military operations. Further continuing the logic, the next step adds space interactions to the land, sea, and air interactions. When adding the space medium, the space-to-space interaction is analogous to the land-to-land, sea-to-sea, and air-to-air interactions. Adding to the matrix, space-to-air, space-to-sea, space-to-land offensive interactions and land-to-space, and sea-to-space and air-to-space defensive interactions fill in the interaction blocks to form a logical four by four matrix. Interactions between all other media continue to be conveniently addressed within this matrix. As media are added to the land-land base, the higher degree medium at each stage adds greater mobility to the forces involved. Also, the greater mobility creates more complexity resulting from the higher degree interactions at each stage.

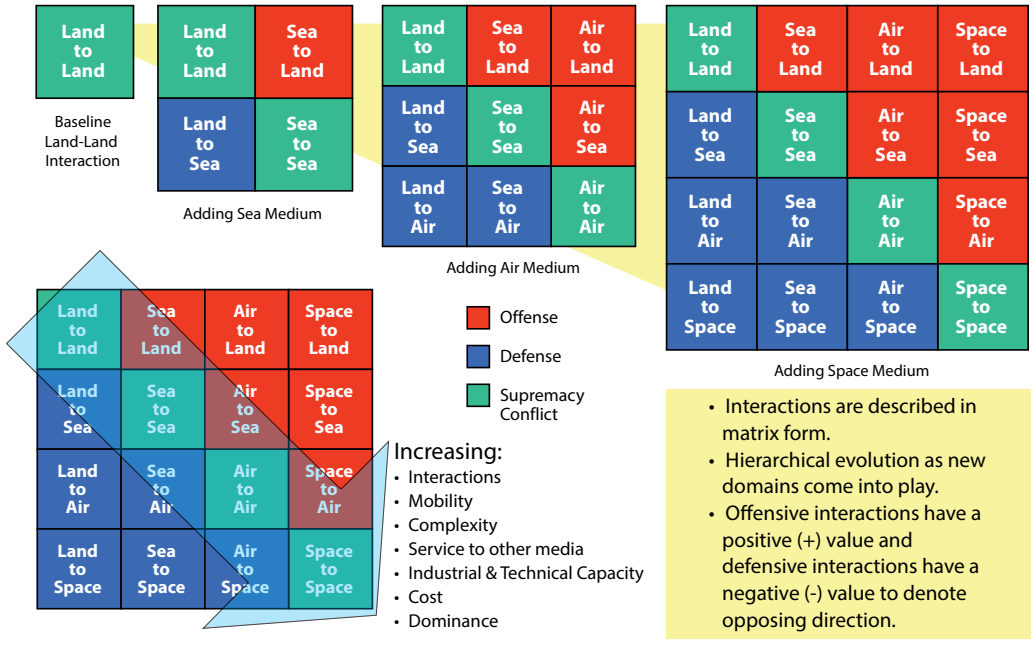

Figure 3. Media domain interaction warfare theory matrix evolution and general attributes

Corbett defines offensive forces as having a positive attribute and defensive forces as a countervailing opposite attribute, resulting in a direct counter for each other in tactical and operational scenarios. Similarly, this theory defines offensive interfaces as having a positive aspect and defensive interfaces with a negative aspect.

Assuming a mathematical/geometric construct, each box in the matrix can be represented by a number of relative merit, strength, or other relevant value for force structure denoted by the matrix location. These numeric values can be viewed as an n-degree vector on either the associated matrix's columns or rows. It should also be clear the medium matrix of degree (n) can be constructed, and this medium construct can be thought of as an "n-space" volume in a geometric sense.

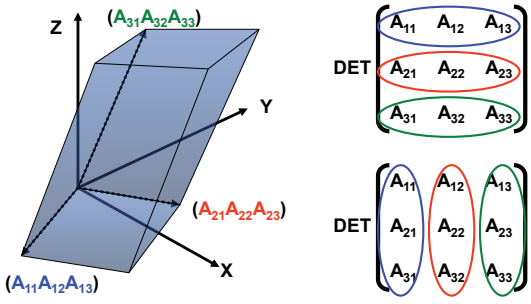

Figure 4. Determinants provide n-space volumes—matrix determinant equals parallelepiped volume in n-dimensional space.

One generally recognized method to calculate an n-space volume is to calculate a determinant. A determinant is used in matrix algebra, a higher order math, to determine a single matrix value. A determinant is calculated by a closed-form equation dependent on the matrix degree. Before modern times, matrix determinants have been considered "magical" by the mathematics community as they manifest many special properties, but they bear little more than a mention in modern matrix algebra books. The fact the determinant is a single-value matrix representation is most interesting. Vectors represent the n-dimensional volume "sides" as shown in figure 4. The main special property is the determinant is a linear function of the first row. Given "everything begins and ends on land," we can choose to make all other matrix values dependent upon defensive land operations or make all other matrix values dependent upon offensive land operations. Given offensive operations are inherently more mobile, and as a result, more dominant as matrix degree increases, we chose to make the matrix dependent on the offensive land vector.

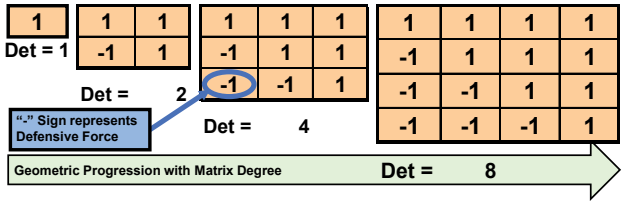

Figure 5. Using identity matrices for simplification, maximum relative interaction strength can be observed through each identity matrix's determinant for the degree medium involved.

For a simple illustration, unity matrices are used. A "1" or a "0" represents all or nothing. When using these identity matrices, we assume all other factors are, in fact, equal. A negative one, "-1," represents a defensive force, while a positive one, "1," represents an equal strength offensive force. Under this construct, the land-land force determinant is "1." The fully populated land-sea matrix determinant is "2." The fully populated land-sea-air matrix determinant is "4," and the fully populated land-sea-air-space matrix determinant is "8." This treatment validates and quantifies the intuitive idea the higher degree force structure is stronger than the lower degree force structure. Everything else being equal, a land-sea force is twice as strong as a land force. A land-sea-air force is twice as strong as a land-sea force, and a land-sea-air-space force is twice as strong as a land-sea-air force (See fig. 5).

Several implications become evident from this mathematical construct and may become axioms with respect to applying this approach to military theories. First: the best way to defeat a force within a certain medium is by a force in that same medium—that is, land forces are best to defeat land forces, naval forces are best to defeat naval forces, air forces are best to defeat air forces, and space forces are best able to defeat space forces. This matrix theory attribute justifies the ideas over the ages of military domination, command of the sea, air superiority, and space superiority discussed by many military theorists. Second: a land force alone cannot defeat a naval force. Third: a land and sea force alone together cannot defeat an air force. Finally, a land, sea, and air force alone cannot defeat a space force. These rules apply whether dealing solely with the direct medium interactions or with all interactions within the same degree. This rule set applies since the superior degree media is always more mobile in space and time, allowing access to potential weak spots. Some observers will point out apparent violations where a an inferior media force defeated a sea or air attack. Certainly, local attacks can be defeated. This series of axioms apply in the general sense when all else is equal. As a corollary, where lower degree media cannot defeat higher-degree media, the inverse is true where higher-degree media can defeat lower-degree media forces. Naval forces can defeat land forces, air forces can defeat naval and land forces, and space forces can defeat land, sea, and air forces. Just because they can doesn't necessarily mean they do for many reasons. Again, that is situational, whereas if all other factors are equal, the higher-degree media forces have an inherent advantage over the lower-degree media. These media interaction theory axioms may be summarized:

- The best way to defeat a force is with a force in the same medium.
- An inferior medium force cannot defeat a superior medium force.
- A superior medium force can defeat an inferior medium force.

Another axiom following from media interaction theory is general superiority in any given medium cannot be achieved unless superiority in all higher media has been achieved. Figure 6 shows a cascading relationship between media: space superiority must be achieved before air superiority is achieved, air superiority must be achieved before command of the sea is achieved, and command of the sea is necessary before land domination is possible. This relationship is predicated on all media (domains) being involved, (one can argue a military scenario involving a landlocked area, sea power is significantly diminished in importance). With that said, it doesn't mean there's a temporal relationship where one superiority level has to precede the next superiority level before the following occurs, although there's some history to that flow. As superiority contests will be occurring in all warfare media simultaneously, all this axiom says is superiority in an inferior medium cannot occur until superiority in all higher-degree media has been achieved. It is conceivable superiority in all media could occur simultaneously in an all-out struggle.

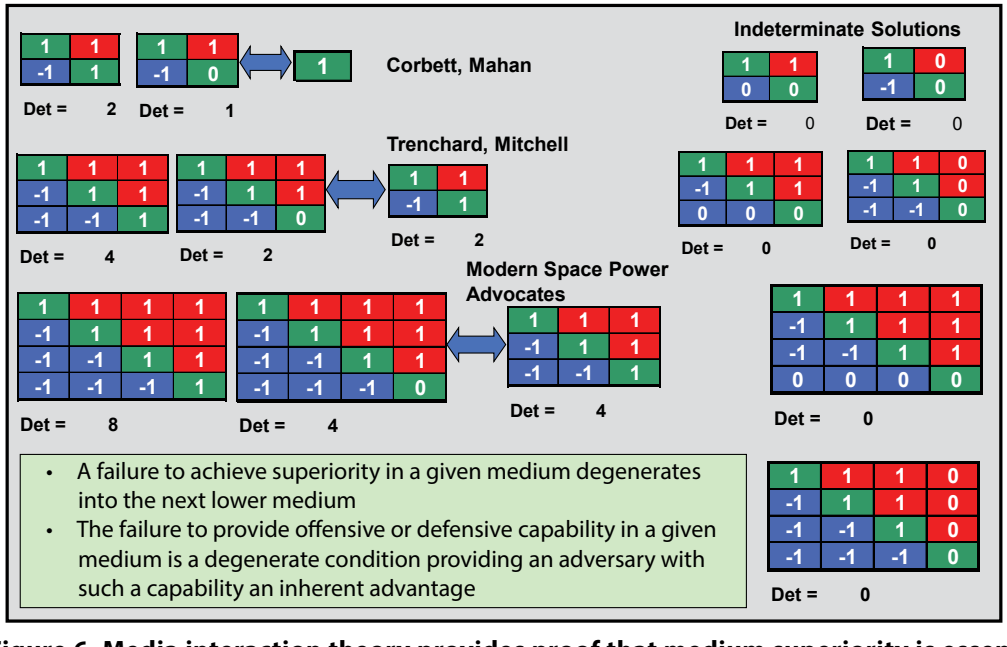

Figure 6. Media interaction theory provides proof that medium superiority is essential in multidomain conflict.

The matrix can be filled out with an infinite range of values, grounded in reality to provide rationally intuitive and nonintuitive results. An infinite variety of possible force structures can be evaluated. However, unless the matrix produces an indeterminate (zero) solution or is fully populated at the maximum values, it is very much possible to have two or more widely different force structures with

essentially the same overall capabilities or alternatively having force structures convention says should be equivalent but are widely disparate in their capability.

Two additional general rules can be stated with the regards to meet superiority in a given medium:

- A failure to achieve superiority in a given medium degenerates into the next lower medium.
- The failure to provide offensive or defensive capability in a given medium is a degenerate condition providing an adversary with superior capability an inherent advantage.

This point is applied to the condition when one combatant has the capability and the other doesn't, whether by intent, design or through loss. These rules apply when a new medium is added to the mix.

Applying Media Interaction Warfare to Military Theories (Classical Air and Contemporary Space Power)

The media interaction theory supports or refutes past military theorists and how general characteristics and rules may be divined from the theory. Applying the theory to airpower, Hugh Trenchard and Billy Mitchell advocated the need to win and maintain air superiority early into World War I. Both officers also supported a broad airpower capability mix. In a land-sea-air media matrix, as shown in figure 7, if the capability to achieve and maintain air superiority is missing, all else being equal even with rudimentary offensive and defensive capabilities, the force structure is not any more powerful than a simple land-sea matrix. Therefore, at the simplest level, Trenchard and Mitchell were right in their theories, and in the purest form, their theories expanded upon the sea power theorists.

One airpower theorist, Giulio Douhet, was mistaken in one of his main ideas. Using the media interaction theory to evaluate and examine his premise, only offensive airpower matters, and bombers alone were the superior force. As stated previously, without air-air superiority, the land-sea-air matrix degenerates in capability to half its full potential.

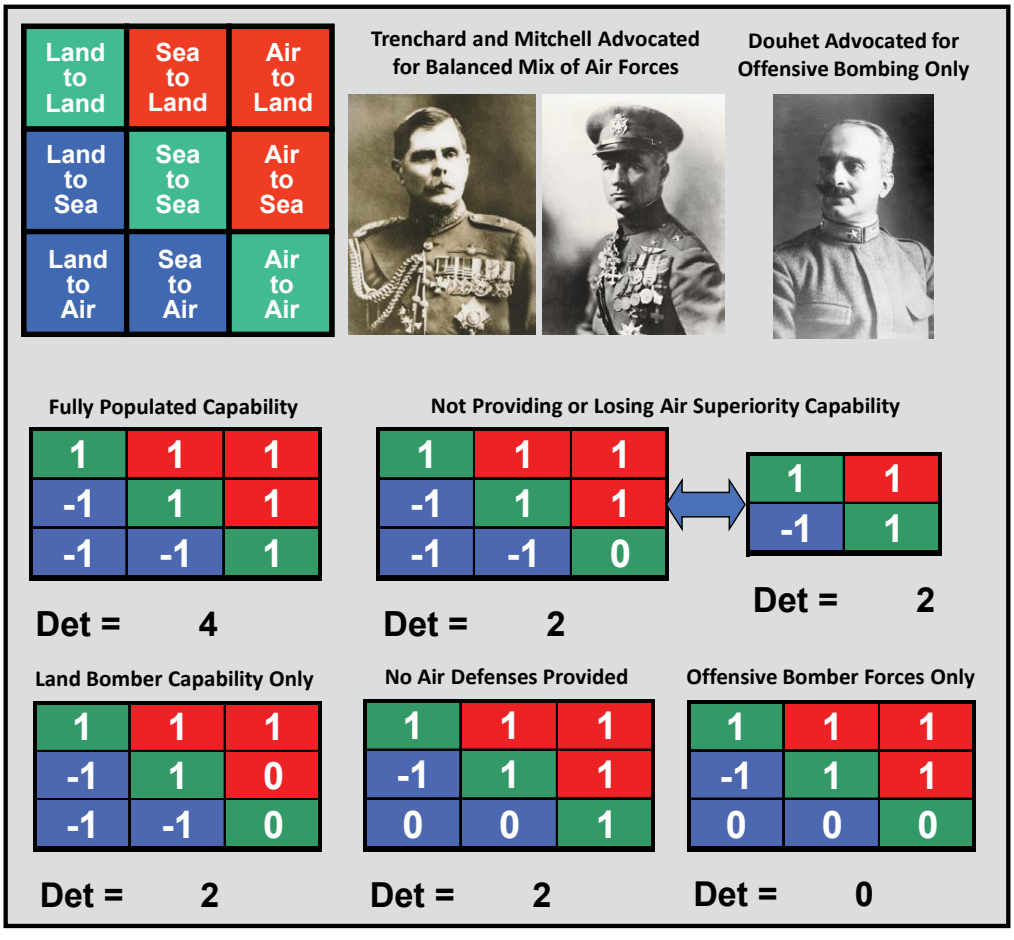

Figure 7. Trenchard and Mitchell were right, Douhet was wrong: air-air superiority is essential, air offense alone is disadvantageous, and neglecting air defense completely is an indeterminate condition. You must have air superiority to win.

This point alone should refute Douhet, but eliminating defensive air forces also degenerates to half the capability. Removing offensive airpower except for land-ground forces likewise degenerates to half power. Eliminating all defensive airpower, including air-air, is a degenerate case. Airpower, to be effective, must have the ability to achieve and maintain air superiority and must have integrated offensive and defensive capabilities; otherwise, there is probably no utility to having air forces at all.

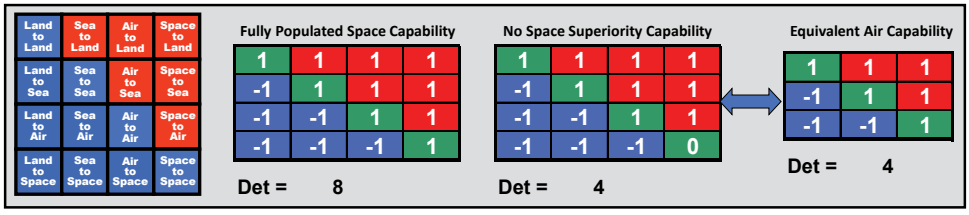

Figure 8. Media interaction theory applied to space power. Space as "the ultimate high ground" is a valid concept, and space superiority is essential to achieve superiority in other media.

Analogous to the land-sea and the land-sea-air matrices, the land-sea-air-space matrix likewise shows space superiority as essential. Without space superiority, the land-sea-air-space matrix has the same value as a fully populated land-sea-air matrix. The land-sea-air-space matrix is indeterminate without offensive or defensive space capabilities. There's common wisdom existing today only defensive counterspace is either necessary or less expensive. This common wisdom is wrong. Just as with air forces, an integrated force structure is necessary in the space medium for military effectiveness. In this modern age, space superiority is absolutely essential if superiority in any other media is to be achieved. The space power advocates who have claimed space as the ultimate high ground are essentially correct. Now, how to achieve offensive space capability and what capabilities cobble together to form an offensive strength in the space medium is a matter of debate. Space offensive strength can be achieved via other media (i.e., ground-based satellite jammers [offensive land-space] stationed on the land media, but the effect is on the space media)—one factor making space superiority analysis more complex than other media.

Since space power does not truly exist today, it's a good idea to make some predictions based upon the matrix theory to provide fodder for future verification. The first prediction has already been stated and is evident: the best way to achieve space superiority is with space-space capability (see fig. 8). Several obvious corollaries, such as how negating an enemy's space activities, are best done from space. Other predictions are illustrated in figure 9. From a defensive point of view, perfect space-space and air-space capabilities would mitigate the need for land-space and sea-space defenses, with all else being equal. In the real world, this prediction really states space-space and air-to-space defenses are far more important than land-space and sea-to-space defenses. This prediction does not consider actual strategic, tactical, and defense in-depth needs.

Similarly, from an offensive point of view, with all else being equal, perfect space-space and space-to-land capabilities produce no need for either space-sea or space-air capabilities. Given the "everything begins and ends on land" axiom, this observation makes intuitive sense. These predictions are the tip of the iceberg.

We could make many more explicit and implicit predictions based on applying different values to the media interaction theory matrices shown.

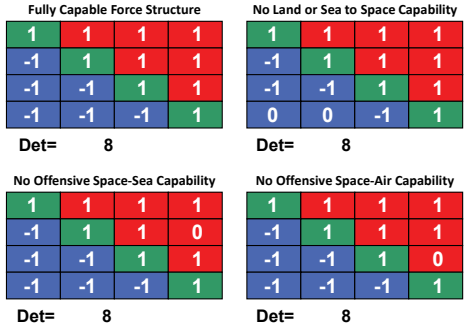

Figure 9. A sampling of media interaction warfare theory idealistic predictions for space power applications

Applying Media Interaction Theory to a Historical Campaign (Guadalcanal in World War II)

We applied this method to several historical battles and found consistency with the history in the cases studied. For this article, we chose to illustrate the Guadalcanal campaign in early World War II as a combined force example of land, sea, and air forces—*a priori*, it is not evident which side had the superior overall force structure. In World War II, the 1942–43 Guadalcanal campaign was the first American offensive in the Pacific Theater. Possessing Guadalcanal was an important contest as the island was strategically located for both sides in the Pacific Theater. The Japanese were endeavoring to cut off sea lanes between America and Australia while the Allies needed to protect those sea lanes to build-up their forces in Australia.[5]

Dates	Battle/Situation	Victor
7 August 1942	American Marines land on Guadalcanal, Tulagi, and Gavutu-Tanambogo. Unopposed on Guadalcanal	American
8 August 1942	Marines secure airfield and name Henderson Field	American
9 August 1942	Japanese naval force defeats allied naval force at battle of Savo island—Allied fleet withdraws	Japanese
18 August 1942	Japanese land reinforcements on Guadalcanal	Japanese
20 August 1942	19 fighters and 12 dive bombers arrive at Henderson Field	American
21 August 1942	Battle of the Tenaru	American
24 August 1942	Naval Battle of the Eastern Solomons	American
12 September 1942	Battle of Edsons's Ridge, near Henderson Field	American
24–27 September and 6–9 October 1942	Battles of the Matanikau	American
11 October 1942	Naval Battle of Cape Esperence	American

Table 2 (*continued*).

Dates	Battle/Situation	Victor
14 October 1942	Japanese battleships bombard Guadalcanal	Japanese
24 October 1942	Battle for Henderson Field, American Victory	American
26 October 1942	Naval Battle of the Santa Cruz Islands	Japanese
13 November 1942	Naval Battle of Guadalcanal	Japanese (Tactical) American (Strategic)
30 November 1942	Naval Battle of Tassafaronga	Japanese
18 December 1942– 4 January 1943 and 10–23 January 1943	Allied land offensives	American
14 January– 7 February 1943	Japanese evacuation operations	American

Table 2. Guadalcanal campaign summary. Land, sea, and air were all closely contested.

The American landings came as a complete surprise to the Japanese. There were numerous ensuing land, sea, and air battles. Several significant land battles occurred temporally close to large sea battles, and air superiority was contested throughout the campaign. In the end, the island and its environs were contested over approximately seven months with America and its allies victorious when the Japanese evacuated the islands. Table 2 summarizes the actual Guadalcanal campaign history. Studied and evaluated in many ways over the years, the Guadalcanal campaign was unique for including land, sea, and air forces in a sufficiently small microcosm whereby evaluation using this media theory is relatively simple and straightforward.

The Guadalcanal campaign had relatively well defined geographic "lines" which acts as a control boundary—forces inside the boundary are considered relevant to the campaign, and forces outside the boundary effectively did not contribute. The campaign had force structure elements engaged which fully populates the media theory force matrix structure. In World War II, the air, sea, and land battles around Guadalcanal were not effectively or intentionally coordinated. However, they were still integrated land, sea, and air forces by default, all contributing to the outcome. The fight over Guadalcanal can be summed up as an attrition battle between two opposing forces over several months. As such, the total force structure certainly matters, and the ability to assess and compare different force structures effectively would be very useful and insightful.

Media theory application can be summarized with a general process. There are three primary steps in applying media theory to determine relative force structure comparisons. The first step is the necessary research to develop an order of battle. The second step is to score the order of battle. The final step is to apply the media theory by filling out the matrix with the total scored forces in each element and then taking a matrix determinant (see fig. 10).

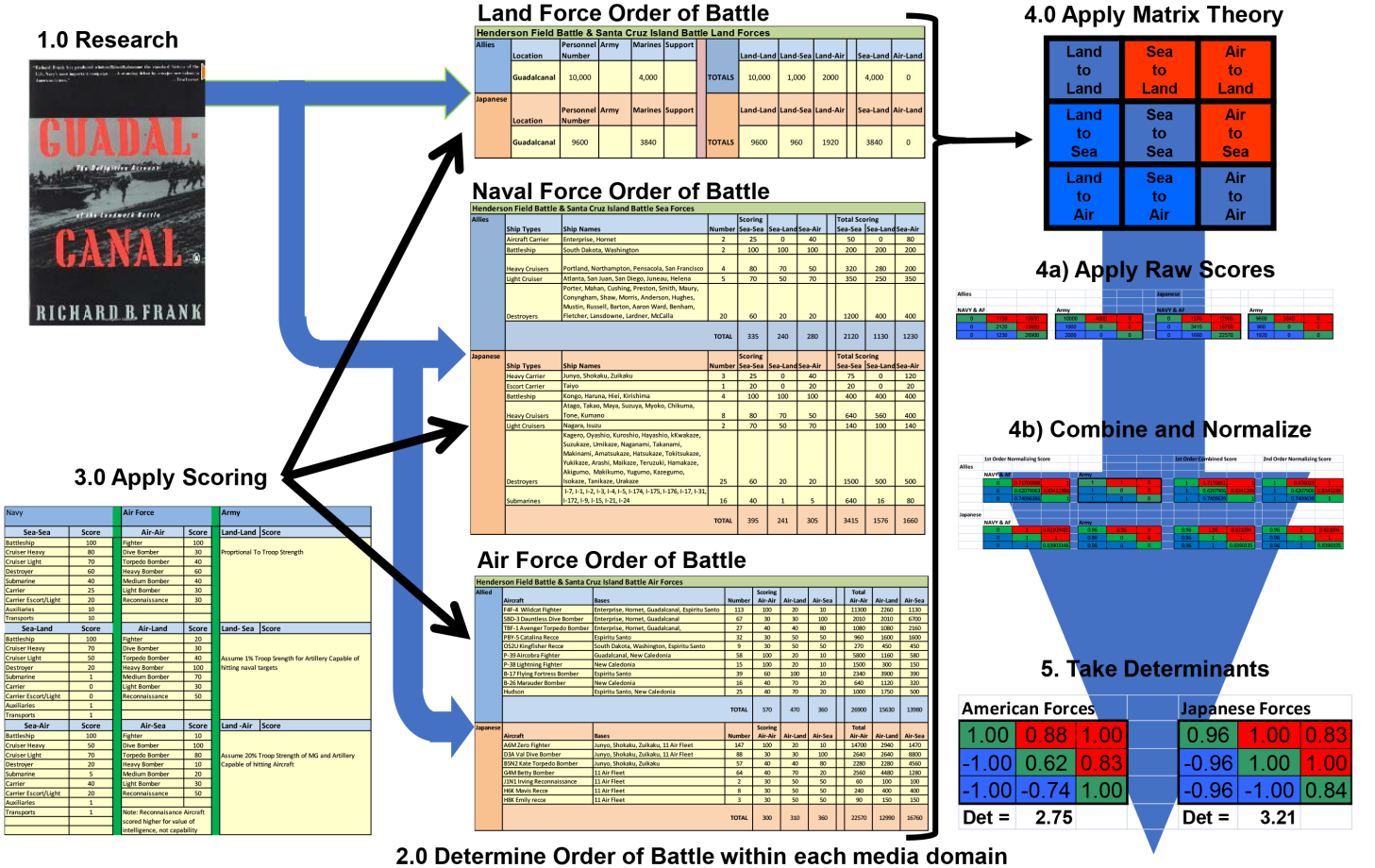

Figure 10. Media Matrix Theory Process applied to the Guadalcanal campaign (one of five events shown as an example)

The Guadalcanal campaign was evaluated at five distinct checkpoints. The first point was the American landings; the last point was when the Japanese withdrew their forces. The middle three points cover land and sea battles occurring within a few days of each other. These points were selected both for their significance and for the fact full land, sea, and air orders of battle were available and distributed evenly over time. From research, the order of battle was generated for each picked checkpoint.

Values were placed on the land forces for land-land, land-sea, and land-air capabilities. Likewise, values were placed on sea forces for sea-sea, sea-land (including Marines), and sea-air capabilities. Finally, values were placed on air forces for air-air, air-sea, and air-ground (including paratroops) capabilities. Scoring was subjective but not arbitrary. For example, battleships scored higher than cruisers which scored higher than destroyers for both sea-sea, and sea-land capabilities. Fighter aircraft scored higher than bombers for air-air but lower for air to ground. Dive bombers and torpedo bombers scored higher than fighters and bombers for air-sea, and so forth. To score the Guadalcanal campaign force structure elements without getting too deep into details, we modeled equivalent forces as quantitatively the same while ignoring any qualitative differences. For example, due to its armor and armament, the Imperial Japanese Navy *Yamato* battleship could be considered superior to the USS *North Carolina* battleship. Both ships participated in the Guadalcanal campaign, but they are assumed to be equivalent weapons classes for the purposes of the analysis, so any battleship is the same as any other battleship. Likewise, cruisers equaled cruisers, destroyers equaled destroyers, and so forth.

Similarly, the Mitsubishi Zero is generally acknowledged as the better air superiority fighter as compared to the Grumman Wildcat, but for this analysis, they are scored the same. Likewise, a Japanese soldier is equivalent to an American Soldier regardless of the actual reality either way. This scoring methodology also allows "home team biases" (i.e., internal evaluations like "I know my fighter is superior to the enemy, so it should be double the strength value of the enemy's asset" tend to overestimate the domestic capability and underestimate the foreign capability; this tendency is especially true in situations where intelligence information confirming those beliefs are lacking) to be relatively mitigated throughout the analysis.

The scoring is then applied to each campaign checkpoint's order of battle by simply multiplying the force numbers times the scoring for each capability within the framework. The scores are tallied and placed in the appropriate matrix theory cell for each campaign's major force. Raw scores are normalized to the highest value between like cells when comparing two force structures. The matrices are normalized with respect to each other. The determinant for each matrix is calculated, and the resulting scores are compared.

1.0 Initial Landings

American Forces		
1.00	1.00	1.00
-1.00	1.00	1.00
-1.00	-1.00	1.00
Det =	4.00	

Japanese Forces		
0.37	0.22	0.23
-0.37	0.35	0.19
-0.37	-0.35	0.19
Det =	0.11	

2.0 Tanaru & East Solomons

American Forces		
1.00	0.65	1.00
-1.00	0.45	1.00
-1.00	-0.50	1.00
Det =	1.89	

Japanese Forces		
0.96	1.00	0.70
-0.96	1.00	0.75
-0.96	-1.00	0.99
Det =	3.24	

3.0 Henderson Field & Santa Cruz

American Forces		
1.00	0.88	1.00
-1.00	0.62	0.83
-1.00	-0.74	1.00
Det =	2.75	

Japanese Forces		
0.96	1.00	0.83
-0.96	1.00	1.00
-0.96	-1.00	0.84
Det =	3.21	

4.0 Naval Battle & Japanese Landings

American Forces		
0.73	0.60	1.00
-0.73	0.52	1.00
-0.73	-0.69	1.00
Det =	1.76	

Japanese Forces		
1.00	1.00	0.61
-1.00	1.00	0.82
-1.00	-1.00	0.58
Det =	2.38	

5.0 Japanese Withdrawals

American Forces		
1.00	1.00	1.00
-1.00	0.86	1.00
-1.00	-1.00	1.00
Det =	1.76	

Japanese Forces		
0.26	0.68	0.54
-0.26	1.00	0.54
-0.26	-0.54	0.47
Det =	2.38	

Conclusion: The Guadalcanal Campaign was a near run endeavor. Allied leadership and perseverance tipped the balance.

Figure 11. Guadalcanal Matrix Theory application results

By following this process, we create a single number representing force structure value, which can be compared against other force structures evaluated in the same way. The final normalized combined force evaluation matrices and the determinant results for each evaluated point are displayed in figure 11. There is one matrix and determinant for the Allied forces and one for the Japanese forces at each named checkpoint.

Since the Americans only dominated in total force structure at the campaign's beginning and end while the Japanese dominated at all other times, the Allies could have easily lost the Guadalcanal campaign. The battle was a close-fought near-run campaign. This analysis indirectly points to the overall superior Allied leadership, tactics, techniques, procedures, and perseverance. If the Japanese had better leadership and employed their available forces more effectively, they might have won.

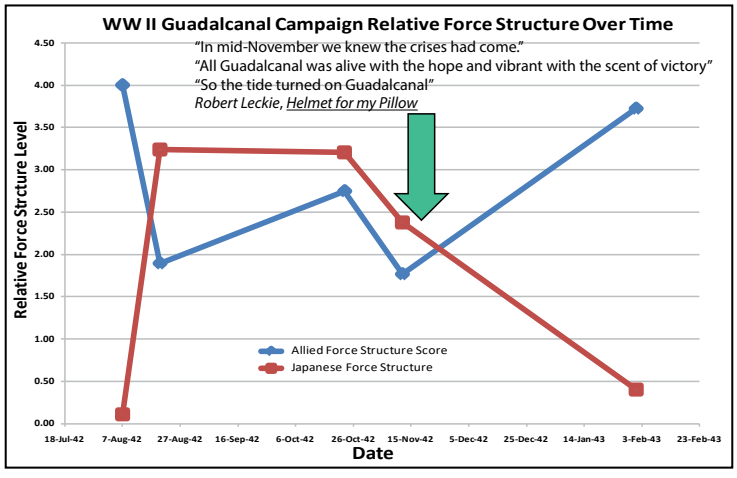

Figure 12. Force structure relative comparison over time shows the dominating integrated order of battle at each point during the World War II Guadalcanal campaign.

By plotting the analyzed campaign checkpoints from figure 11 over time and "connecting the dots," an interesting picture appears.

The analysis performed was based on the prebattle force structure order of battle for each checkpoint. Otherwise, the analysis was completely agnostic to the actual history and situation at any point in time. However, by connecting the dots shown in figure 12, a clear crossover point between Japanese force dominance and Allied force dominance occurs approximately in November 1942. As noted in the figure, according to Robert Leckie in his book, as well as other authors, analysts, and commentators, the Guadalcanal campaign appeared to move in the Allies' favor in November 1942. This coincidence is a tremendous qualitative affirmation the theory has some potency in force structure evaluation. Though not covered here, this media matrix analysis may be applied to "what if" situations by changing the order of battle as desired to see the outcome.

Applying Media Interaction Theory to Space (Hypothetical NATO-Warsaw Pact Engagement)

Now, how can we apply this theory to space forces? Based on the work described so far, we assume the media theory represents a valid means to describe and compare combined force structures. Also, all else being equal, the media theory results predict the likely outcome of a conflict between two opposing integrated force structures. Given these axioms, we can apply the media theory to a hypothetical NATO-Warsaw pact conflict circa 1985 with and without some conjectural space forces that could have existed at that time (see fig. 13).[6]

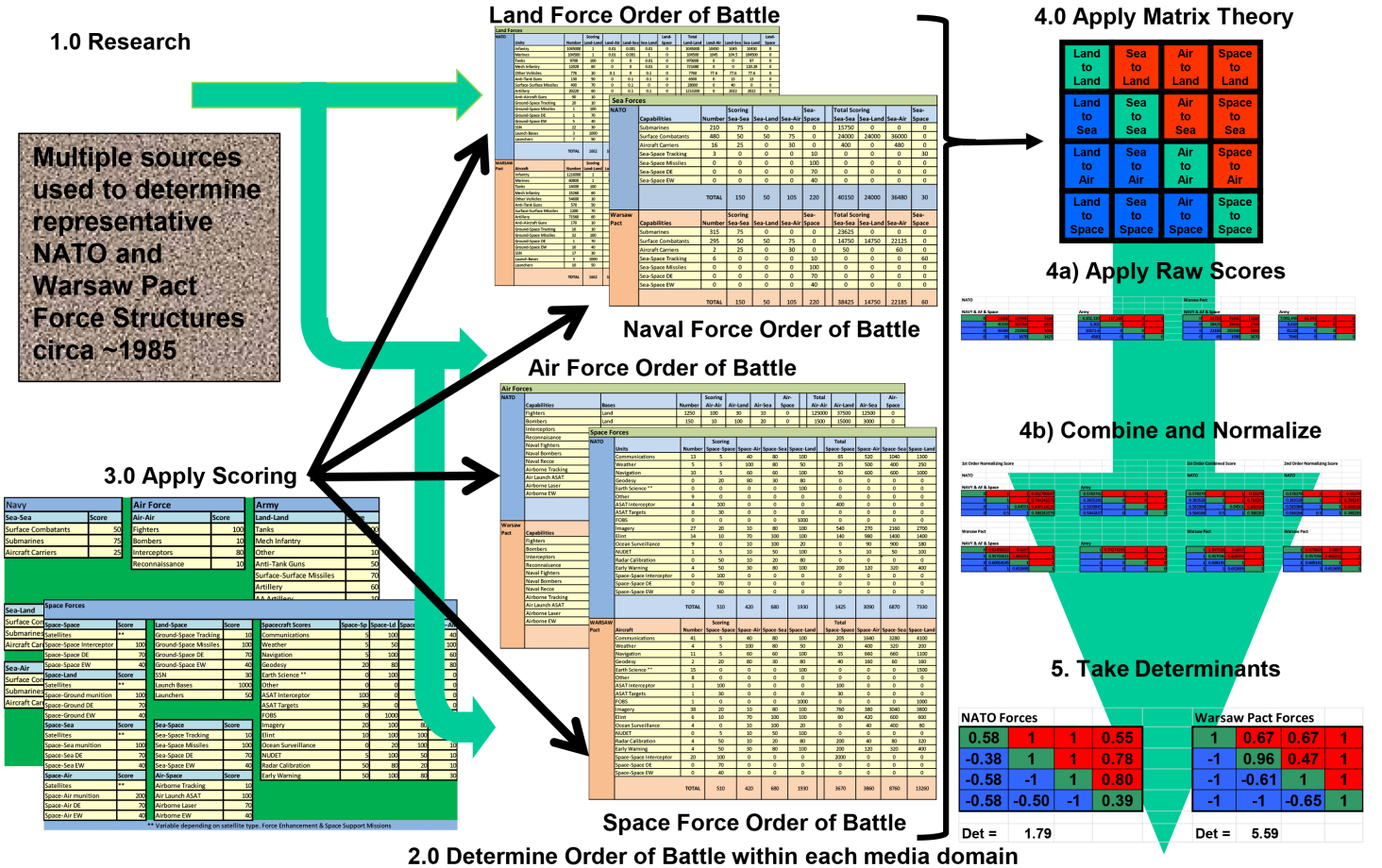

Figure 13. Media Matrix Theory applied to NATO versus Warsaw pact Cold War campaign, including hypothetical 1985 space forces

Using the available open sources, we established 1985 as the approximate year the force structures were valid for a hypothetical conflict between NATO and Warsaw Pact forces. Though the data is not valid for any specific point in time, the resulting order of battle for both sides is generally representative in this era. For space forces, open literature research and development capabilities at the time were used to estimate space force hypothetical capabilities—that is, ISR satellite capabilities for both combatants, US F-15 ASAT, USSR SL-11 Coorbital ASAT, USSR Sary Sagan Laser, US MIRACL Laser, and others. Nuclear forces were not included in this analysis. Scoring is adjusted to reflect these more modern "circa-1985" systems and their associated capabilities as opposed to the World War II-era capability scoring done previously. Otherwise, the scoring application to the order of battle, media theory application, and determinant results are the same as was performed for the previous Guadalcanal analysis.

The '60s-'80s held contentious debates in the West over whether NATO's conventional forces in Europe could withstand the Warsaw Pact onslaught without resorting to nuclear weapons. Many different quality versus quantity arguments were made regarding whether NATO or the Warsaw Pact forces were superior, particularly when comparing land, naval, or air forces directly.

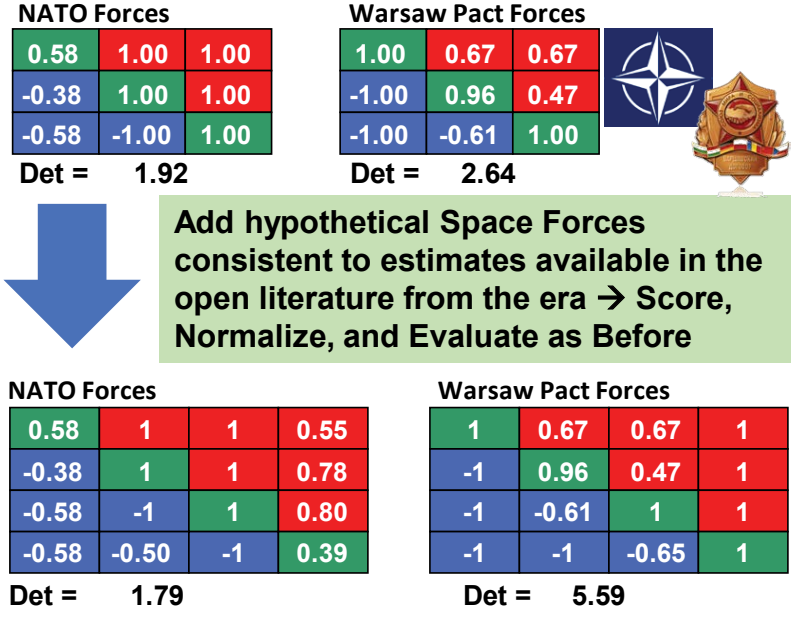

Figure 14. Vintage 1980s NATO versus Warsaw Pact force structures show superiority, both with and without space forces included.

When comparing force results directly (fig. 14), the Warsaw Pact had clear dominance over all land forces, but NATO and the Warsaw Pact were at or near parity for naval and air forces (look at the diagonals). Over land-sea-air diagonals, NATO has clear domain over offensive capability, while the Warsaw Pact does better defensively (except in sea-air). Intuitively, one could guess the NATO forces are superior. However, media theory application says the Warsaw Pact force structure in total was 27 percent superior to the NATO force structure.

Adding in the hypothetical space forces to the same analysis, the Soviet Union appeared to have superior capability in conducting space warfare for the time period. However, the superiority was not completely uncontested. Intuition would assume the superior space forces added to the dominant force structure would lead to an even greater superiority. However, by applying the media theory and comparing results, the analysis indicates the Warsaw Pact would have had 300 percent greater superiority over NATO forces. This result appears to be an overwhelming supremacy. If this analysis has any factual basis, it was a very good thing NATO and the Warsaw Pact never actually crossed conventional swords over Europe. This analysis also reinforces the nuclear deterrent's strategic importance. In evaluating operational or tactical engagements, media theory suggests the Warsaw Pact should have pressed the advantage; that they did not emphasize the overwhelming impact strategic weapons had on the decision to engage.

Summary/Conclusion

The media interaction warfare theory extends past work by military theorists to unify a large degree of their work through modern mathematical techniques. The theory proposes a construct using matrix algebra to represent land, sea, air, and space force structures. This construct is applied to validate or refute past military theories, help explain past historic events, and predict future possible situations—most notably in analyzing potential multidomain operations or campaigns. The theory strongly endorses space force utility and importance when integrated into an overall force structure. The media interaction theory may also be used to illustrate and analyze military service roles and missions and any force structure mix variety. The media interaction theory provides one of the first analytic tools to emerging US Space Force planners and strategy developers. If this theory is valid, it opens-up a distinct, logical approach to joint forces analysis, modeling, and simulation; also, the approach has broad applicability to the world of military affairs, and space force warfighting capability importance and applicability to those affairs. ✪

Michael P. Scardera

Mr. Scardera (SB, Massachusetts Institute of Technology; MS, University of Maryland) has more than 36 years' experience in aerospace engineering and leadership roles. He is currently vice president of Advanced Concepts at Millennium Space Systems, A Boeing Company, where he is responsible for early stage space system concept and program development for future flight programs. He leads teams responsible for developing space systems from concept through detailed design and supporting subsequent development activities through launch and operations. Previously Mr. Scardera was director for aerospace systems at Innovative Technology Systems and chief systems engineer at Pioneer Rocketplane. He served 12 years as a USAF officer, innovating in space superiority, space control, space surveillance, and global positioning system mission areas.

B. T. Cesul, PhD

Dr. Cesul (BS, University of Michigan; ME, University of Michigan; PhD, Air Force Institute of Technology) is a technical fellow and principal systems engineer (space) with Centauri, now a KBR company. He is responsible for supporting customers in national security space and the commercial utilization of space capabilities. Dr. Cesul previously worked as a space systems engineer and principal intelligence analyst for multiple entities within the national security space community.

Notes

1. Michael P. Scardera, "Media Interaction Theory of Warfare (Military Domain Matrix Theory), A Hypothesis Unifying Past Military Theories and The Theoretical Basis for an Independent U.S. Space Force," 76th Military Operations Research Society Conference (MORS), US Coast Guard Academy, 10–12 June 2008; and Michael P. Scardera, "Media Interaction Theory of Warfare (Military Domain Matrix Theory)—An Update; Applying the Media Interaction Warfare Theory," 80th MORS Conference, US Air Force Academy, 12–14 June 2012.

2. Land power source material surveyed included: Sun Tzu, *The Art of War*, trans. Samuel B. Griffith (New York: Oxford University Press, 1971); Carl Von Clausewitz, *On War*, trans. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1984); Antoine-Henri Jomini, *The Art of War*, trans. G. H Mendel and W. P. Craighill (Long Beach, CA: Apostrophe Books, 1862); B. H. Liddell Hart, *The Remaking of Modern Armies* (Boston: Little, Brown and Company, 1928); B. H. Liddell Hart, *The Revolution in Warfare* (New Haven, Yale University Press, 1947); and Brian Bond, *Liddell Hart, A Study of his Military Thought* (New Brunswick, NJ: Rutgers University Press, 1977).

3. Naval power source material surveyed included: Alfred Thayer Mahan, *The Influence of Sea Power Upon History 1660–1783* (New York: Dover Publications, 1987); Philip Howard Colomb, *Naval Warfare, Its Ruling Principles and Practice Historically Treated, Volumes 1, 2, & 3* (Annapolis, MD: Naval Institute Press, 1990); and Julian Corbett, *Some Principles of Maritime Strategy* (Annapolis, MD: Naval Institute Press, 1988).

4. Airpower source material surveyed included: Giulio Douhet, *The Command of the Air*, trans. Dino Ferrari (Wright-Patterson AFB, OH: Air Force History and Museums Program, 1998); William B. Mitchell, *Memoirs of World War I* (New York: Random House, 1960); William Mitchell, *Winged Defense* (New York: Dover Publications, 1988); Andrew Boyle, *Trenchard, Man of Vision* (London: Collins, 1962); and Walter J. Boyne, *The Influence of Air Power Upon History* (Gretna, Louisiana: Pelican Publishing, 2003).

5. The source material used to describe the Guadalcanal Campaign and construct the Order of Battle include Richard B. Frank, *Guadalcanal: The Definitive Account of the Landmark Battle* (London: Penguin Books, 1992); "A Guadalcanal Chronology & Order of Battle 7 August 1942–6

March 1943," http://www.friesian.com; "Solomons Campaign: Guadalcanal," Naval History and Heritage Command, https://www.history.navy.mil; John Miller, Jr., "United States Army in World War II—The War in the Pacific, Guadalcanal: The First Offensive," https://www.ibiblio.org; Joseph N. Mueller, *Guadalcanal 1942—The Marines Strike Back* (Oxford, Osprey Publishing, 1992); and Robert Leckie, *Helmet for my Pillow, From Parris Island to the Pacific* (New York: Bantam, 2010).

6. The source material used to describe the North Atlantic Treaty Organization (NATO) versus Warsaw Pact European War Scenario and construct the Order of Battle include: "An Assessment of Soviet Forces Facing NATO—The Central Region—and Suggested NATO Initiatives," DNA 4343 F, 30 September 1977, https://apps.dtic.mil; "Assessing the NATO/Warsaw Pact Military Balance," Congressional Budget Office, December 1977, https://www.globalsecurity.org; and Christopher Redman, "East-West Battle of the Bean Counters. If Euromissiles are outlawed, will NATO be outgunned?" *Time Magazine* 129, no. 24, 15 June 1987.