

# Techniques for Great Power Space War

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## Abstract

Based on the study of military history for the past 50 years, and direct involvement with space warfare programs for the past 46 years, the author has developed general rules by which the next space war may be conducted. These concepts can lead to a full set of space warfare doctrinal principles, rules, escalation concepts, and termination criteria. This article offers a practical view of space war fighting outside the normal style of *SSQ*. The value of this piece comes from the author's unusually rich experience in space and other military programs and is offered as a chance to spur reader thought and input. Since a space war has not yet occurred, all of these ideas are notional and unproven. Nonetheless, it is productive to better understand how a future great power space war might be conducted to ensure favorable outcomes by analyzing fundamentals of space warfare, rules for its conduct, space war escalation control, and criteria for space warfare termination.

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Space and space warfare compose a somewhat unique domain when compared to terrestrial warfare. For instance, space warfare has global coverage and is responsive within a few hours anywhere on Earth. As well, many countries use commercial and civil imagery and radar satellites that benefit the military and civilian sectors at the same time. Space war can be conducted to heighten emotions and may drive countries to terrestrial conflicts. It is the penultimate expression of unmanned automated systems—with possible weapons.

Contrary to popular belief, space is not a target-rich environment where just about every target is strategic and costs millions of dollars. It is also the most difficult environment for verifying attacks with hostile intent, for subsequently validating which country or entity was responsible, and for determining the impact of space attacks on the final outcomes of terrestrial battles and wars. Further, an adversary's ability to conduct surprise attacks in space is easier than with terrestrial attacks. The significant dif-

ference between space and terrestrial realms is that we have many concrete examples of warfare on Earth, whereas a space war is too conceptual with no real experience on which to ground our frame of reference. In addition, real space warfare may seem like an elaborate video game played by satellite controllers. As a result, even participants in a space war are not as affected by the potential implications of their actions.

Recently, much has been said about a Space Force and the probability of space wars. There is a significant buildup of space warfare capabilities by some major powers who rely on space systems for their defense or perceive that their potential adversaries depend too much on space capabilities. However, because of the lack of extensive experience in this new military domain, it is difficult to fully understand what the best doctrine, strategies, and tactics are to win the next space war. This begs the question, Does the United States have the foundational principles by which future space wars can be won? Future space warfare strategies and tactics for great power conflict in space have not been proven for any country, and yet the future of space warfare is rapidly approaching.

In their book *Chinese Aerospace Power*, scholars Andrew Erickson and Lyle Goldstein find it interesting that Chinese space warfare doctrine closely resembles German strategic doctrine in the twentieth century.<sup>1</sup> The Chinese have the same strategic outlook, as they believe the United States would prevail in any protracted conflict due to superior technology. Thus, the stage is set for space blitzkrieg at the beginning of any great power conflict between China and the United States. Would the Chinese strike our space assets in a lightning-quick surprise attack or simply position themselves to threaten our space assets so we hesitate in our responses and self-deter? If we also position our space control assets that threaten Chinese space systems, does this create an imminent strategic impasse, which can quickly, and inadvertently, devolve into general space war due to poor space situational awareness (SSA)? Does the side that attacks first generally win future space wars? Does all of this sound similar to the risks of nuclear war but without the self-deterrence of mutual mass destruction? The Chinese are starting from scratch in developing space warfare theory and doctrine and are not hindered by long space traditions. Over the past 50 years the United States has not felt the need to develop space warfare doctrine. It might have better and more numerous space forces than any potential adversary, but if the US lacks the proper doctrine, strategies, and tactics, then it is open to defeat by more agile forces. Adversaries may be new to this domain and thus may have more flexible and innovative plans—particularly for surprise attacks. Current space warfare thinking

can be enriched by extending the traditional doctrine, strategies, and tactics of terrestrial warfare into the space environment.

This article sheds light on the issue by exploring the strategies and principles of space warfare. It provides a set of rules for decision makers to prosecute war in space along with ideas on conflict escalation and termination of space warfare. While it may be difficult to determine whether a space anomaly is an intentional attack, unintentional occurrence, or natural cause, understanding potential adversary attack options will help considerably in determining optimal responses.

### **Strategies and Principles of Space War**

Certain strategies, such as surprise or application of mass attacks, are just as applicable today in futuristic space systems as they were 2,500 years ago in a Greek phalanx.<sup>2</sup> How one conducts war (military doctrine) is the key aspect of winning conflicts. There are many examples in military history where one force that appeared superior on paper was summarily defeated by a much “inferior” force because it had better doctrinal concepts and implementations.

Space war fighters usually consider only the tactical level of war and ignore the operational and strategic implications. The deep political nature of space war definitely requires that all operators be fully aware of the repercussions of their actions outside of the tactical realm. Denying the capabilities of a single adversary satellite may also deny the intelligence community’s ability to monitor that threatening space system. Attacking an adversary satellite would directly reveal allied intentions and war plans, imply possible future operations, and expose space capabilities previously unknown to adversaries. An even more critical consequence is the possibility that employment of space weapons will cause allied and adversary political realignments post-conflict.

Many are familiar with the ancient Chinese military scholar Sun Tzu (544–496 BC) and his classic *The Art of War*, which he wrote while studying classical military strategies and tactics. What may be surprising is that these ancient principles are still applicable to today’s space warfare. The infancy of space warfare thinking creates a situation where simply applying these ideas into a space warfare strategy could prove decisive in a future space battle. For example, if predictive battlespace awareness (PBA) techniques indicate a potential adversary is pre-positioning some of his threat assets for some near-future space attack, a good defensive strategy based on Sun Tzu’s principles would be to constantly maneuver your satellites to complicate the adversary’s targeting solutions. One may also ma-

neuver some satellites close to an adversary to threaten and disguise true intentions. The Sun Tzu-derived strategy examples for space warfare are listed below:<sup>3</sup>

- Constantly or intermittently conduct small maneuvers to frustrate an adversary's ability to calculate precise orbital parameters to target allied satellites and prevent it from understanding allied space plans, doctrine, strategies, and tactics.
- Only use space weapons if the effect is commensurate with the political and financial costs, loss of future surprise, and loss of future capabilities (weapon system magazines used up and consequences of adversary responses affecting Blue and Gray systems).
- Study an adversary's space doctrine, strategies, tactics, organizations, and leadership personalities to discover his strengths and weaknesses so you may better catch him off guard during space systems surprise attacks.
- Continually harass the fixed space systems defenses of your adversaries so they are constantly off-balance, more hurried, and less timely in fulfilling their mission objectives.
- Remember, you are not fighting an adversary's forces and machines as much as you are fighting an adversary commander's perceptions, biases, experiences, training, organizational structures, upper military and political superiors, intelligence, mental and emotional strengths, weaknesses, and endurance. The weakest point in a space system may be the human element, including scientists, engineers, technologists, and additional supporting staff.
- Dangle out in front of your adversaries tempting space systems targets to draw out their space control resources, military plans, and intentions.
- Those who start conflicts and attack first know the best place and time of the coming space battle.
- Due to orbital dynamics and continual satellite movement, the place and time of the coming battle is constantly moving and changing. This unpredictability requires different strategic and tactical perspectives than do terrestrial battles and demands unique graphical solutions and highly dynamic computer processing to support battle planning.
- Many times, those who get to the battle the quickest are the winners, not those who wait in order to concentrate the most forces.

- A good space plan requires your adversaries to come at you and use up their maneuvering resources more so than yourself, allowing allied systems to perform more aggressive attacks later on.
- You may sacrifice some space assets to make your adversaries believe in your carefully falsified military objectives.
- Periodically launch new space vehicles to keep your adversaries confused and off balance.
- Launch or maneuver a new, mysterious satellite that comes close to critical adversary satellites to make your adversaries pause in their military execution plans, to show resolve, and to warn them to back down.
- Heavily defend certain orbits to force an adversary's spacecraft to other orbits of your choosing.
- During space conflicts you may decide to trade orbital space for time. In other words, you may give up key orbits and maneuvering room solely because it will take your adversaries some time to fill this void or chase you down, or simply force them to use up valuable satellite fuel, while giving yourself more time to make better counterattack preparations.
- Initiate multiple false starts—threatening space and terrestrial maneuvers, for example—to induce your adversaries to begin constant satellite maneuvering so as to waste their on-board fuel reserves before actual conflict starts.
- The most easily accessed orbits might also be the best killing zones.

### ***Space Centers of Gravity***

Centers of gravity are also important for creating and executing a space warfare strategy. According to Joint Publication (JP) 5-0, *Joint Planning*, a center of gravity (COG) is “a source of power that provides moral or physical strength, freedom of action, or will to act.”<sup>4</sup> This concept applies equally to space warfare and terrestrial operational planning. It is not a concept that is well understood with current space battle management planning. Figure 1 is an attempt to evolve the Centers of Gravity model developed by Col John Warden and extend it to space warfare planning.<sup>5</sup> Figure 2 takes this model a step further and starts to delineate space political/military COGs, along with will and intent, as major factors in an adversary's ability to wage war.<sup>6</sup>

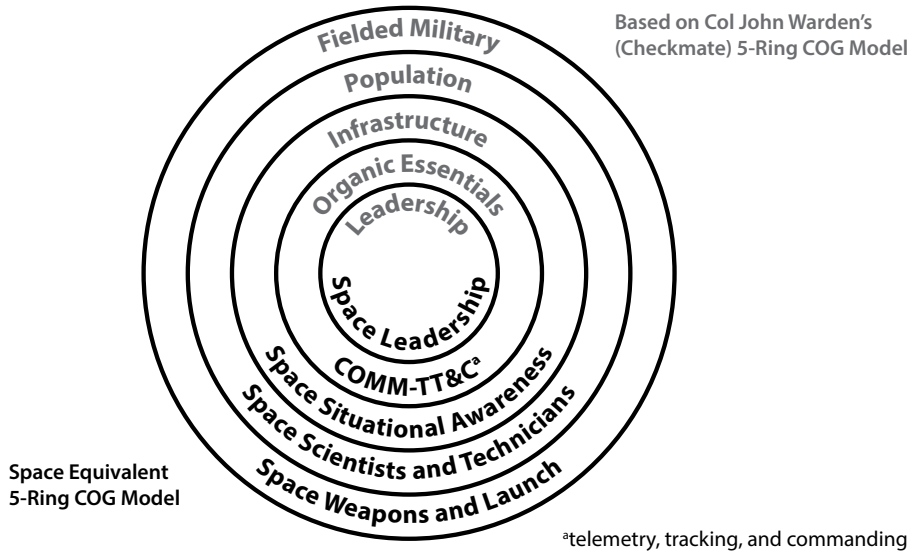


Figure 1. Space Centers of Gravity model

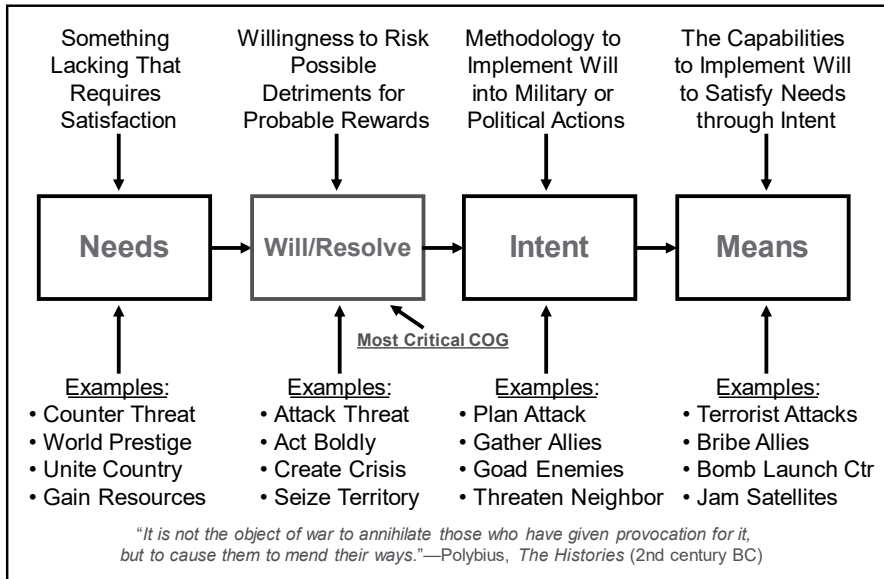


Figure 2. Space political/military COGs

While strategies and centers of gravity are essential for planning to successfully fight a space conflict, time-honored principles of war must also be considered.

## *Principles of Space War*

Classical military principles of war can and should be applied to space warfare. The distinction between terrestrial versus space usage is noteworthy, and the nine principles below are instructive.<sup>7</sup> Whether for space or terrestrial warfare, the principles are the same. However, there are aspects of space that should be better understood when applying these principles. The space principles of war are framed as a series of questions space planners should ask.

- Objective
  - **Terrestrial:** *“Direct every military operation toward a clearly defined, decisive, and attainable objective with measurable effects.”*
  - **Space:** Are your objectives to take out an individual satellite or a total system capability that may be supported by both satellites and ground systems? Will taking out the satellite be decisive in denying that category of information? Does it have a measurable impact on the battlefield? Which military objectives does this system support? Is satisfaction of these objectives achievable?
- Offensive
  - **Terrestrial:** *“Seize, retain, and exploit the initiative.”*
  - **Space:** Is there political will to start a space war at the beginning of a terrestrial conflict and seize the space initiative, or is taking out ground sites supporting space sufficient to achieve objectives? Are we setting the time, place, and terms of the space battle? Does the battle tempo include space attacks on a continuing basis to keep the adversary off balance? Can space weapon systems sustain continuous attacks? Is there a preapproved ramp-up of space attack severity to exploit successes for further gain?
- Mass
  - **Terrestrial:** *“Mass the effects of overwhelming combat power at the decisive place and time.”*
  - **Space:** Are there sufficient weapons to achieve continuous or sustained space control? Can the adversary reconfigure his space systems to avoid attack? Are the space weapons overwhelming to the military function they are trying to deny? Is there political will to implement massed space attack? Can space weapons get into position at the decisive place and time? Do we actually know the decisive place and time for space weapons application? Can multiple space weapons be synchronized for employment simultaneously and coordinated with terrestrial attacks?

- Economy of Force
  - **Terrestrial:** *“Employ all combat power available in the most effective way possible; allocate minimum essential combat power to secondary efforts.”*
  - **Space:** Are all space control efforts and weapon systems integrated into one deployment/employment plan? Is the target list optimal with minimal weapons use? Are different phenomenology weapons attacks integrated (e.g., cyberattack synchronized with laser combined-arms attacks)? Are the results of space control decisive to the battlefield? Are all space control systems employed purposefully at all times of the conflict—even in delay, limited, or deceptive kinds of attacks that focus the adversary’s attention away from the main space attack?
- Maneuver
  - **Terrestrial:** *“Place the enemy in a position of disadvantage through the flexible application of combat power.”*
  - **Space:** Have space weapons been deployed in optimal positions and time-space phasing? What is the effect on the adversary of space weapons use? Has the “high ground” of space above the battlefield been won? Are there critical orbits/time phasing/launch corridors/communications paths around the world contributing to the battlefield that need space superiority consideration? Has access to space been denied to the adversary and his allies and optimized for the Blue side and allies? Has Blue freedom of action been maximized while minimizing Red freedom of action in space? Are points of application of space control weapons constantly shifted to confuse adversary response and also avoid predictable patterns of operation for survivability reasons? Have critical space superiority systems been serviced with maneuvering fuel prior to space conflict?
- Unity of Command
  - **Terrestrial:** *“For every objective, seek unity of command and unity of effort.”*
  - **Space:** Have space control, information war, and air/ground attack plans been integrated with each other and with intelligence collection requirements? Does the “classic” target allocation process give sufficient consideration to space/info targets? Is there adequate space/info war delineation of chain of command and decision responsibility? Are space target lists traceable back



to objectives (both Red and Blue)? Do Blue and Red terrestrial commanders appreciate the importance of space to their conduct of the war? Since space is global, have Blue allies been part of the space warfare decision-making processes?

- Security
  - **Terrestrial:** “*Never permit the enemy to acquire unexpected advantage.*”
  - **Space:** Are space forces, including weapon systems, survivable in the battlefield environment? Have operations security (OP-SEC) and fratricide concerns been met? Have Blue space choke points (orbits/time phasing/launch corridors/communications paths), centers of gravity (telemetry, tracking, and commanding [TT&C] and launch sites), logistics, and command structures been identified and protected? Does Blue have alternative space-related sensor, processing, command, and communications paths? Are Red space strategies, tactics, doctrine, organization, commanders, and intentions assessed?
- Surprise
  - **Terrestrial:** “*Strike the enemy at a time or place or in a manner for which he is unprepared.*”
  - **Space:** Does the adversary know that space control weapons exist or that they have been deployed to the theater? Do these weapons have covert war operating modes to surprise the enemy? Are there a series of surprise space control weapons that can be alternated to maintain cover? Is the use of these weapons detectable or attributable to a specific country by an adversary? Timing and tempo of space weapons use can also surprise, even if their existence is known. Threats of weapon use, even if the weapon does not currently exist, can effectively surprise.
- Simplicity
  - **Terrestrial:** “*Prepare clear, uncomplicated plans and concise orders to ensure thorough understanding.*”
  - **Space:** How complex are space weapons, and are the effects of their use easily understandable by non-space Blue and Red commanders (do they know they’ve been hurt bad)? Are there branches and sequels to space control operations if they fail or if they are successful?

## **Rules for Conducting Space Warfare**

Strategies and principles are underlying determinants of success in space warfare. However, certain rules will be essential once the fighting begins. Such rules could be the difference between victory and defeat. These rules are the key elements of how to fight and win the next space war.<sup>8</sup> Most importantly, before any major military conflict is initiated on the Earth, a smart adversary would likely position threatening space assets at key locations in space to better enable surprise attacks while minimizing maneuvering fuel requirements. If countries invest in space situational awareness networks (radar, optical, and intelligence) on the ground and in space, they can be prewarned of impending space attacks and confront the adversary—possibly averting both terrestrial and space conflicts.

**1. *Satellite Posture:***

Dominating and survivable preconflict satellite positioning and extensive satellite on-board maneuvering fuel are of prime importance.

**2. *Space Awareness:***

Perceptive SSA and predictive battlespace awareness will dominate any offensive weapons capabilities.

**3. *Doctrine and Will:***

Effective doctrine and decisive political will are most necessary to counter adversary military actions in the space environment.

**4. *Maneuver:***

A satellite's ability to frequently conduct large, small, or continuous maneuvers—especially just before and during a space conflict—might be the best capability to keep your adversaries guessing as to your space control intentions and planning (besides complicating their targeting solutions), especially when they may lack worldwide space surveillance sensor coverage.

**5. *Unusual Orbits:***

Unusual orbits increase the difficulty of your adversaries in determining your intentions or targeting you quickly.

**6. *Pre-conflict Positioning:***

Since it is very difficult to change orbits at the last minute (especially changing orbital inclination), immediate space combat can only be fought with the current resources on hand in the local area. There will be no trans-conflict redistribution of space forces to help those forces under immediate attack. Thus, pre-conflict positioning

of space assets is possibly the most important aspect of space strategies. This principle is related to the other fundamental principle of maximizing high-maneuvering abilities of space assets.

**7. *Value of Space:***

Due to the newness of space warfare, your adversary probably does not fully understand the true value of space both to himself and to his opponents. This complicates his ability to prioritize his targeting plans and may contribute to him wasting precious maneuvering fuel and limited “shots” from space weapons, along with ceding time and tempo advantages to the other side.

**8. *Political Consequences:***

Due to the newness of space warfare, our adversary and probably we do not fully understand the political, diplomatic, economic, and international ramifications of employing space weapon systems, especially for post-conflict impacts.

**9. *Effective Doctrine:***

Due to the newness of space warfare, our adversary and probably we do not fully understand the best theory, doctrine, strategies, tactics, and techniques for conducting optimized space warfare. Big mistakes will be made by both sides.

**10. *Mistakes Will be Made:***

Due to the newness of space warfare, most carefully laid plans, doctrines, strategies, tactics, and techniques as well as political, technological, and correlation of forces assumptions will prove false and be immediately thrown out (or worse, be so dearly held that they lead to immediate defeat). This rule applies equally to both sides of the conflict unless one side is lucky enough to have gotten space doctrine slightly more correct than the opposing side.

**11. *Vary Space Weapon Types:***

Due to the newness of space warfare, it might be best to possess different phenomenology space weapon systems with varied basing options. Doing so will increase the chances that you developed your preplanning and space doctrine correctly for a type of conflict that has never occurred before. Remember, in all previous wars the first casualties were primarily the pre-conflict plans.

**12. *Define Winning:***

The concept of “winning” in space warfare is not clearly defined. Its definition may be created by political leaders with limited tech-

nological or military knowledge and be based on purely political, propagandistic, or failed doctrinal principles. Your adversary will certainly have a very different definition of winning, which means both sides may perceive they have “won” the space conflict and derive quite different conclusions that will dominate their military, political, diplomatic, and economic (commercial and procurement strategies) thinking for decades to come. To be in a favorable position post-conflict, a nation should consider these factors in the space strategies it employs during a conflict, the future political effects, and adversary and allies’ post-conflict reactions.

**13. *Space Debris:***

Creation of too much space debris during space conflicts may make losers out of all sides after the conflict in the long term.

**14. *Future Political Effects:***

You may be assured that after the conduct of a major space war, national and international protocols, treaties, rules of conduct, and alliances will be radically changed for space.

**15. *Adversary Post-conflict Reactions:***

You may be assured that after the conduct of a major space war, your adversaries, and other nations, will learn from this war and probably build up their own space weapon capabilities—even if necessarily covertly.

**16. *Space Escalation Ladder:***

Due to the remote nature of space systems, the world’s populace may be kept in the dark (especially for low-level space conflicts) about what is truly happening, which provides additional, more subtle rungs on the conflict escalation ladder, allowing nations to privately exhibit resolve and to send determined political messages.

**17. *Space Warfare Inherently Conflict Destabilizing:***

Because a small, relatively inexpensive space mine can take out a large billion-dollar satellite critical to the conduct of your military operations, and actual satellite point defense is problematic due to possible antisatellite (ASAT) hypervelocity closing speeds, offense is probably better than defense in space warfare, making it inherently unstable for conflict escalation control.

**18. *Quick Space Attacks Possible:***

Due to the remote nature of satellites in space, small-scale space attacks may be initiated, executed, and completed before the

recipient even knows it is under attack, who is attacking, what the attack strategies and goals (end states) are, and when an uncomprehending senior political leadership can validate the attack and respond in a military, political, diplomatic, or economic manner. Large-scale space attacks may be initiated, executed, and completed within 24–48 hours. Without adequate and timely SSA and determined and decisive political will, an adversary can easily get within your observe, orient, decide, act (OODA) command and control loops for space and subsequently shock and confuse you.

**19. *Space Exhibits Escalation Imbalances:***

Due to the remote nature of satellites in space and the difficulty for space surveillance assets to determine the true nature of space attacks, and because space attacks may be initiated, executed, and completed within 24–48 hours, there is a good chance that the side that initiates space attacks first will be the side that wins the space war.

**20. *Covertiness and Surprise of Prime Importance:***

Due to the remote nature of satellites in space and the difficulty for space surveillance assets to determine the true nature of space attacks, and because space attacks may be initiated, executed, and completed within 24–48 hours, covertness and surprise will significantly contribute to winning the space war.

**21. *Joint Military and Commercial Space Use:***

Mixing military and commercial systems on the same satellites increases the chances of space conflict escalation due to the general populace immediately becoming aware of the effects of satellite loss, subsequently creating pressure on political leadership to take precipitous actions. Thus, the nuances of steady and reasoned escalation control are lost.

**22. *Space Only Benefits Terrestrial Systems:***

Space conflict is all about denying satellite support to military forces or civilian populations on Earth, not simply the elimination of satellite systems for destruction's sake or as a space war "scorekeeper."

**23. *Small Space Forces Can Beat Larger Ones:***

As in many other conflicts past and present, having space forces that appear superior in numbers and technological quality on paper does not guarantee a win under all circumstances. There are many examples throughout thousands of years of military history of nu-

merically inferior forces beating their “betters.” Many times, it is the forces with better doctrine, planning, morale (political will), or positioning that win. This can only be truer for a new area of conflict in space that has little, if any, past military examples and experiences.

**24. *Decisive Political Will:***

Having space forces that are superior in numbers and technological quality are useless if there is not the decisive political will to fully and quickly employ them. This principle may imply that dictatorships are more at an advantage than democracies. Hesitation and uncertainty can rapidly lead to failure in outer space warfare.

**25. *Space Situational Awareness and Weapons Range:***

It does not matter how plentiful or how brilliant your adversary's space weapon systems are if they cannot find or reach your critical space systems. If you are constantly maneuvering so that the adversary cannot find you, your satellites are in hard-to-reach orbits or have low observables, or you possess many believable satellite decoys, then he can never dominate you.

**26. *Public Opinion Will Limit Military Options:***

Even though space wars entail very few, if any, human casualties, international public opinion values space wars as more politically unacceptable compared to terrestrial destruction and loss of human life from traditional warfare on Earth. In addition, space wars will fire the imaginations, good or bad, of your citizens, along with much of the rest of the world that is not actively participating in the conflict.

**27. *Allies Count Little Militarily for Space Wars:***

Due to the limited number of countries with future space weapons systems and their attendant need for covertness, along with international political sensitivities, each adversary will probably have to go it alone, and its allies cannot or will not significantly help it openly in the coming space conflict.

**28. *Space Treaties Will Be Violated:***

Most space treaties will be violated in the first few hours of the coming space war. International treaties have usually been violated in most previous major terrestrial conflicts and, due to the remoteness of space, treaties concerning the military use of space are

easier to ignore—especially when the world populace may not even be aware of this ongoing space conflict and treaty violation truth will be hard to come by.

**29. *Data Relay Satellites Are Prime Targets:***

Possibly the most important space targets will be satellites that relay data and commands directly to other satellites in remote orbits, making them choke points for critical space systems. This is particularly true for those countries without extensive worldwide satellite ground control stations.

**30. *Defense versus Offense:***

Nations that have more space systems being used by their military also have more space systems to defend—and probably must emphasize defense over offense in their technology developments and military planning. If your adversary has few space systems, then there are fewer targets for your offensive space weapons, and you must emphasize defense. This is the case unless you believe that you have perfect SSA and know all of your adversaries' and their allies' offensive space weapons. You must also believe that you can target and neutralize these weapons early in the space conflict before adversaries can fully implement their offensive space warfare plans. In past military history, overconfidence in the ability of intelligence collections assets has led to certain defeat.

**31. *Space Situational Awareness Is Prime:***

Because of the inherent instability of offense versus defense in space warfare, the most essential tool for senior military and political space leaders is space surveillance and identification sensors with corresponding automated assessment algorithms, particularly those that provide PBA.

**32. *Space Warfare Systems Are Untested:***

If your adversaries have space warfare systems untested in real, sustained combat, then their true abilities against you are uncertain and probably possess “cracks in their armor.” Unfortunately, the same is probably true of your space warfare systems (whether you believe this or not), but the true vulnerabilities and failure

points of both sides may not be obvious or believable. However, due to the new nature of space warfare, be assured that they do exist in plenitude.

**33. *Differing Cultures and Military Traditions:***

Because your adversaries probably come from different cultures and military traditions than your own, their differing perspectives allow them to have a higher probability of detecting your space warfare systems' nonobvious "cracks in their armor" than you do, and vice versa.

**34. *You Are Always Vulnerable:***

As in all military matters since time immemorial, due to the cleverness of human beings especially under stressful combat conditions, your adversaries will ultimately find your vulnerabilities and get through any defenses you may fool yourself into thinking are invulnerable.

**35. *Decisive Commanders:***

For those countries at war with roughly equal space warfare forces, the main decisive factor could be which country may be lucky enough to discover and believe in the one decisive commander who is a genius in space warfare organization, doctrine, strategies, and tactics. This premise would hold especially true for the non-traditional nature of space warfare. In addition, those countries with the least meddling in military matters by their politicians might be the decisive factor in winning the war (though possibly "losing" the peace afterwards).

**36. *Little to No Human Casualties:***

Because space warfare involves little to no human casualties, commanders can be particularly decisive and cold-hearted in their planning and execution compared to terrestrial warfare. As Lt Gen Roger G. DeKok, a former US Space Command vice commander,



stated, “Satellites have no mothers.”<sup>9</sup> In addition, morale and courage on the battlefield are of less importance, though command decisiveness remains a critical factor.

**37. *Low-Cost Offensive Weapons:***

Due to the hypervelocities of space orbits, one cannot adequately armor spacecraft, and a small, relatively inexpensive space mine can take out a large billion-dollar satellite critical to the conduct of your military operations.

**38. *Space “Fog of War”:***

The potential for confusion known as the “fog of war” is well documented for terrestrial battlefields. It will be even worse for space warfare due to the newness of this theater for conflict, the tremendous distances involved, and the global nature of space.

**39. *Commercial Satellites Are on Their Own:***

Commercial satellite operators whose expectations are that the military will protect their space systems during conflicts will have a rude awakening.

**40. *Checklist Vulnerability:***

Operators trained to respond to unusual situations by checklist actions can be easily spoofed and manipulated by a clever adversary, especially in a contested environment with denied or degraded communications to higher headquarters.<sup>10</sup>

## **Space Conflict Escalation Control**

General escalation in space can intensify or even initiate conflict on Earth. A critical aspect of space warfare is limiting the conflict to specific levels of weapons employment in specific theaters of operation. At the same time, space provides additional rungs on the conflict escalation ladder, enabling countries to show resolve. Senior leaders in Washington would likely require absolute proof of who the attacking country is when our satellites are destroyed before they would allow any counterstrikes. Since attacking ASAT systems do not have big red stars painted on their sides and are likely constructed of Western parts, quick attribution is quite problematic. It may essentially cause self-deterrence and paralysis of national leadership decisions. Currently, if a satellite stops working, determining the cause takes weeks and months and is ultimately only a guess since these space systems cannot generally be directly imaged. US adver-

saries do not seem to practice self-deterrence. As a result, the space war may well be over before the United States even knows it began.

The following tables give a preliminary basis as to which actions in space may cause potential adversaries to respond in an escalatory manner. Table 1 depicts what kinds of attacks may be permitted according to the current level of conflict. In other words, if potential adversaries are generally at peace with allied nations, then there are more restrictions on weapons types that can be employed than if conventional war has already broken out. Possibly only probing and reversible cyber-type attacks would be allowed in peacetime, but more permanent, damaging attacks could be executed in general wartime situations.<sup>11</sup> Also note that this table distinguishes between general terrestrial and space conflict as execution of space conflicts might be hidden from the general population. Finally, weapons release authorization levels are only for satellites that cover and support the area of Earth currently in conflict, making them legitimate targets. Satellites outside the conflict zone might have more limited weapons release authorities.

**Table 1. Weapons release rules of engagement**

Rules of Engagement (ROE)					
<i>Level of War</i>	<i>Deception</i>	<i>Disruption</i>	<i>Denial</i>	<i>Degradation</i>	<i>Destruction</i>
Peace	Yes	Maybe	No	No	No
Space Crisis	Yes	Yes	Yes	No	No
Conventional Terrestrial	Yes	Yes	Yes	No	No
Conventional Terrestrial & Space	Yes	Yes	Yes	Yes	Yes

Table 2 shows notional weapons release authorization levels for different levels of conflict. The weapons release authorization levels are defined in the appendix and are based on air warfare doctrine.<sup>12</sup> Table 3 offers the probability of conflict escalation if more severe weapons are employed than necessary for that particular conflict level. Note that these are perceived conflict levels and weapons' severity of effects, and your adversary may be living by an entirely different rule book when it comes to space warfare. This is even truer for space conflicts, as the vast distances involved increase the ability to employ plausible deniability of any knowledge of what happened to a satellite.

**Table 2. Potential conflict escalation.** (Assumes satellite does support area of responsibility [AOR] of current concern or conflict.)

Weapons Release Authorization Level					
Level of War	Space Positive Control	Space Autonomous Operation	Space Weapons Hold	Space Weapons Tight	Space Weapons Free
Peace	Yes	No	No	No	No
Space Crisis	Yes	Maybe	Maybe	No	No
Conventional Terrestrial	Yes	Yes	Yes	Maybe	No
Conventional Terrestrial & Space	Yes	Yes	Yes	Yes	Maybe

**Table 3. Probability of conflict escalation.** (Gives the probability that weapons use will increase conflict level.)

Weapons Release Authorization Level					
Level of War	Space Positive Control	Space Autonomous Operation	Space Weapons Hold	Space Weapons Tight	Space Weapons Free
Peace	0%	10%	20%	80%	90%
Space Crisis	0%	20%	30%	90%	90%
Conventional Terrestrial	0%	30%	50%	100%	100%
Conventional Terrestrial & Space	0%	20%	30%	40%	50%

Finally, table 4 shows a potential space conflict escalation ladder that is linked to a terrestrial escalation ladder.<sup>13</sup> This array illustrates how space and terrestrial conflicts can influence each other and possibly spill over from one domain to another. While space wars may occur without corresponding terrestrial conflicts, unnecessary escalation of space conflicts may lead to the start of or escalation of terrestrial war. Additionally, this space conflict escalation ladder is not necessarily sequential as conflict may erupt at any rung of the ladder. It is conceivable that in the future, the country that loses the space war may not even fight a terrestrial conflict and simply capitulate.

**Table 4. Proposed space conflict escalation ladder**

<b>Terrestrial Campaign Phase</b>	<b>Space Campaign Phase Full Name</b>	<b>Escalation Level</b>	<b>Escalation Effects</b>
Phase 0: Pre-war Buildup (Shape)	1st Wave Attacks Phase A – Pre-conflict Deter	Pre-conflict Deter	Deter, Deny
Phase 0: Pre-war Buildup (Shape)	1st Wave Attacks Phase B – Pre-conflict Persuade	Persuade	Deter, Deny
Phase 0: Pre-war Buildup (Shape)	1st Wave Attacks Phase C – Pre-conflict Hide	Covert	Deter
Phase I: Deployment/Deterrence (Deter)	2nd Wave Attacks – Trans-conflict Deter	Trans-conflict Deter	Deter, Deny, Disrupt
Phase II: Halt Incursion (Seize Initiative)	3rd Wave Attacks Phase A1 – Terrestrial-to-Space Partial Temporary Effects	From Terrestrial Partial Temporary Kill	Delay, Deny, Disrupt
Phase II: Halt Incursion (Seize Initiative)	3rd Wave Attacks Phase A2 – Terrestrial-to-Space Total Temporary Effects	From Terrestrial Total Temporary Kill	Disrupt
Phase III: Air Counteroffensive (Dominate)	3rd Wave Attacks Phase B1 – Space-to-Space Partial Temporary Effects	From Space Partial Temporary Kill	Delay, Deny
Phase III: Air Counteroffensive (Dominate)	3rd Wave Attacks Phase B2 – Space-to-Space Total Temporary Effects	From Space Total Temporary Kill	Disrupt
Phase IV: Joint Counteroffensive to Restore Friendly Pre-conflict Status (Stabilize Borders)	4th Wave Attacks Phase A1 – Terrestrial-to-Space Partial Permanent Kill	From Terrestrial Partial Permanent Kill	Degrade
Phase IV: Joint Counteroffensive to Restore Friendly Pre-conflict Status (Stabilize Borders)	4th Wave Attacks Phase A2 – Terrestrial-to-Space Total Permanent Kill	From Terrestrial Total Permanent Kill	Destroy
Phase V: Joint Counteroffensive to Capture Adversary Capitol (Enable New Civil Authority)	4th Wave Attacks Phase B1 – Space-to-Space Partial Permanent Kill	From Space Partial Permanent Kill	Degrade
Phase V: Joint Counteroffensive to Capture Adversary Capitol (Enable New Civil Authority)	4th Wave Attacks Phase B2 – Space-to-Space Total Permanent Kill	From Space Total Permanent Kill	Destroy, Deter
Phase VI: Defend against Adversary Counterattacks against Friendly Homeland	5th Wave Attacks – Space-Manned Permanent Kill	Space-Manned Permanent Kill: Kill Adversary Astronauts	Degrade, Destroy
Phase VI: Defend against Adversary Counterattacks against Friendly Homeland	6th Wave Attacks – Space-to-Earth Permanent Kill	Space-to-Earth Permanent Kill	Degrade, Destroy
Phase VII: Defend Military against Adversary Use of Nuclear Weapons in Space	7th Wave Attacks – NBC Use - Space	NBC Use – Space	Degrade, Destroy
Phase VIII: Defend Military against Adversary Use of NBC against Friendly Military Targets	8th Wave Attacks Phase A – NBC Use - Space & Terrestrial - Military Targets	NBC Use – Space & Terrestrial	Degrade, Destroy
Phase IX: Defend against Adversary Use of NBC against All Friendly Targets (Military & Civilian)	8th Wave Attacks Phase B – NBC Use - Space & Terrestrial - Civilian Targets	NBC Use – Space & Terrestrial	Degrade, Destroy
Phase X: Post-hostilities (Reconstruction & Stabilization)	9th Wave Attacks – Post-conflict Deter	Post-conflict Deter	Diplomatic Actions

Below are the space weapons types permitted for each escalation level in the ladder:

- ***1st Wave Attacks Phase A – Pre-conflict Deter:***  
Overt Weapons Testing and Deployment; Treaties; Saber Rattling; Space Alliances; Normal Space Surveillance, Tracking and Reconnaissance Activities; Satellite Close Inspectors.
- ***1st Wave Attacks Phase B – Pre-conflict Persuade:***  
Diplomatic Requests and Démarches; Economic Actions; Embargos; Legal Actions; Administrative Actions; Transmitting Propaganda Broadcasts; Jamming Propaganda Broadcasts; Increased Spying and Surveillance; Unusual Increases in Space Surveillance and Tracking Activities; Threaten Allies of Your Adversaries; Maneuver to Avoid Attacks.
- ***1st Wave Attacks Phase C – Pre-conflict Hide:***  
Camouflage; Stop Activities; Mobility; Covert Technology Developments; Small Covert Special Operations Forces (SOF) Attacks; Cyber Attacks; Covert Actions in Violation of International Treaties; Cutoff Diplomatic Relations; Inspire Social Disruptions and Agitation; Employ Lethal Force against Your Own Citizens (dictatorships); Mobilize Forces; Increase Military Alert Level (DEFCON); Maneuver Close Enough to Adversary Satellites to Purposely Appear as a Threat; Reveal Covert Programs to Appear Threatening; Enter into War-Reserve Modes (or Hide) for Critical Satellites; Hide Senior Leadership; Increase Radiation Environment in Orbits Used by Adversaries; Initiate Satellite Defensive Measures; Employ Nation's Astronauts on International Space Station for Military Reconnaissance and Surveillance; Spoof and Falsify Worldwide Distribution of Satellite Location Orbital Tracking Data.
- ***2nd Wave Attacks – Trans-conflict Deter:***  
Provocative but False Attacks; Linked Attacks; Demo Attacks; Alternate Country Attacks; Blockades; Major Covert SOF Attacks; Terrorist Attacks; Summarily Execute Saboteurs; Seize and Sequester Suspected Terrorists; Alert Anti-satellite Systems; Arm Satellite Self-Defense Mechanisms; Alert Anti-missile Defenses; Alert Antiaircraft Defenses; Arm Allied Astronauts on International Space Station.

- ***3rd Wave Attacks Phase A1 – Terrestrial-to-Space Partial Temporary Effects:***  
Delay, Deny, Covertly Assassinate Adversary Diplomatic Ambassador; Temporarily Blind Adversary Astronauts with Laser Dazzler; Openly Conduct Electronic Warfare against Adversary Satellite Systems.
- ***3rd Wave Attacks Phase A2 – Terrestrial-to-Space Total Temporary Effects:***  
Disrupt Space Systems (temporary impairment of the utility of space systems, usually without physical damage to the space segments).
- ***3rd Wave Attacks Phase B1 – Space-to-Space Partial Temporary Effects:***  
Delay or Deny Space Systems (temporary elimination of the utility of the space systems, usually without physical damage).
- ***3rd Wave Attacks Phase B2 – Space-to-Space Total Temporary Effects:***  
Disrupt Space Systems (temporary impairment of the utility of space systems, usually without physical damage to the space segments).
- ***4th Wave Attacks Phase A1 – Terrestrial-to-Space Partial Permanent Kill:***  
Degrade Space Systems (permanent impairment of the utility of space systems, usually with physical damage).
- ***4th Wave Attacks Phase A2 – Terrestrial-to-Space Total Permanent Kill:***  
Destroy Space Systems. Also includes Destroying Space-Related Terrestrial Sites and Destroying Direct-Ascent ASAT Missiles with Anti-missile Weapon Systems.
- ***4th Wave Attacks Phase B1 – Space-to-Space Partial Permanent Kill:***  
Degrade Space Systems; Declare Martial Law; Bomb Adversary Populations.
- ***4th Wave Attacks Phase B2 – Space-to-Space Total Permanent Kill:***  
Destroy Space Systems; Threaten to Arrest Adversary Astronauts on International Space Station.
- ***5th Wave Attacks – Space-Manned Permanent Kill:***  
Degrade, Destroy, Arrest Adversary Astronauts on International Space Station.
- ***6th Wave Attacks – Space-to-Earth Permanent Kill:***  
Degrade, Destroy Terrestrial Systems.
- ***7th Wave Attacks – NBC Use – Space:***  
Degrade, Destroy, Alert Nuclear Forces for Defensive Preparations.

- **8th Wave Attacks Phase A – NBC Use – Space & Terrestrial – Military Targets:**  
Degrade, Destroy Space and Terrestrial Systems.
- **8th Wave Attacks Phase B – NBC Use – Space & Terrestrial – Civilian Targets:**  
Degrade, Destroy Space and Terrestrial Systems.
- **9th Wave Attacks – Post-conflict Deter:**  
Diplomatic Requests, Economic Actions, Legal Actions, Administrative Actions, Jamming Propaganda Broadcasts, Forced Population Resettlements.

### **Space Conflict Termination Criteria**

JP 5-0 mandates that the first step of any operations planning is to delineate what the war termination (surrender) criteria must be.<sup>14</sup> This success criteria informs later operational art, including military objectives, effects, tasks, and courses of action. For terrestrial operations, conflict termination criteria are more straightforward, such as seize and hold territory, depose dictators, and destroy military capabilities. However, for space wars these criteria are not so obvious. Can one seize territory in space, effectively deny employment of space weapons, or restrict access to certain orbits?

While not exhaustive, the list below gives some examples of possible space war termination criteria.<sup>15</sup> Space war fighters may adopt these criteria based on political realities and how determined the allies are in preventing additional near-term space conflicts.

1. War political goals are met.
2. Red space force capabilities reduction goals are met.
3. Red space disarmament occurs.
4. The balance of power in space between Red and Blue is sufficient to deter Red from any near-future space attacks for the next 10 years.
5. Red maneuvers satellites outside immediate threat zones that endanger Blue critical space assets.
6. Red cannot image battlefield with less than 1-meter resolution.
7. Red is open to inspection of space launch sites, rocket-fuel production facilities, and space research facilities.
8. All Red terrestrial ASAT sites and programs are revealed.

9. Red provides war reparations for Blue and Gray space systems permanently degraded/destroyed.
10. Red develops program to clean up space debris caused by its military actions.
11. Control of Red inspector satellites is handed over to Blue.
12. Red surrenders some of its internationally assigned geosynchronous orbital position slots.
13. Red establishes a hotline connection between its space command centers and Blue space command centers.
14. Red provides 30 days' notice of all planned future space launches.
15. Red does not approach any Blue critical satellites within 100 meters.
16. Eighty percent of Red satellite refueling on-orbit depots and servicing satellites are shut down.
17. Embargo is established against Red import of sensitive space technologies and subsystems.
18. Red is required to place tracking beacons on all future launched satellites. Blue establishes declaratory policy to immediately neutralize any Red satellites without these tracking beacons for the next 10 years.
19. Red must formally state the mission of each newly launched space object for the next 10 years. The mission is subject to verification by Blue and will be neutralized if any satellites with surreptitious missions are discovered

## **Conclusion**

In military history there are many examples of a military force that appeared superior on paper being defeated by a technically inferior force that is more flexible and with superior doctrinal concepts on how to conduct warfare. This concern can only be amplified by the remoteness of satellites that make it very difficult to verify what attacks are being set up, by whom, and to what purpose. In addition, this new region of warfare has yet to prove the correct doctrinal concepts for efficient execution of commander's intent.

The United States should establish a new organization that will develop advanced outer space warfare theory, policy, doctrine, strategies, and tactics that support the new space force much like Project Air Force and the Arroyo Center. It should be the premier center for understanding the methods



and techniques for conducting military operations in space. What is required is a new theory on space power in the same manner as classical air and sea power theory developed by Mahan, Douhet, and Mitchell or even Sun Tzu and Clausewitz. To be useful, these new concepts must influence the overall command and planning structures in the United States for space and terrestrial warfare planning staffs. Some suggested means for this new organization to accomplish this task include the following:

- Develop models and simulations that test new space doctrinal concepts.
- Sponsor lectures and symposia on critical space warfare subjects.
- Sponsor and fund further research on these topics by commercial contractors and other government agencies.
- Sponsor prizes for the best research papers on space warfare.
- Participate in and/or fund space-related war games, including space impacts on terrestrial war games.
- Provide teaching materials for military space courses.
- Publish papers in military and space journals.
- Fund space chairs at military schools.
- Sponsor student participation in space symposia.
- Provide analyses and briefing material for Congress.
- Support inclusion of space warfare concepts into military doctrine documents such as JP 5-0 and JP 3-14 (*Space Operations*)—both are insufficient for space warfare and require more decisive guidance.
- Assure allied participation in this organization to maximize new ideas, especially in a joint and combined environment such as NATO.

This new space doctrine think tank can be small at first, with only a core group of analysts and some modeling and simulation staff. Prominent space and military experts can be temporarily engaged as consultants and part-time advisors. These advisors can be senior retired officers, government administrators, diplomats, intelligence staff, political experts, and possibly international partners.

For many years the author has been proposing that the Department of State (DOS) be included in any long-range architecture planning for theoretical space weapons technology and system architecture studies. The military can spend years and billions of dollars developing certain types of weapon systems, only to have the DOS prevent their use. If the DOS is involved early in the development cycle, then any diplomatic sensitivities

can be addressed early in the design or choice of weapon phenomenology before spending much time and treasure. The DOS can also recommend when new space treaties need to be developed and old ones renegotiated.

The initial think tank cadre should include not only space experts but also non-space personnel with extensive experience in terrestrial combat operations to assure the widest possible freethinking and integration with terrestrial planning. The core staff can develop new concepts and doctrine for the US Space Force.

The future of space warfare is upon us, but the theory, doctrine, strategies, and tactics are uncertain. Whether you believe in space warfare or are desperately trying to prevent it, conflicts in space will happen nevertheless because space is too important to remain a sanctuary while great power conflicts are raging on Earth. Space remains too connected to the ultimate outcome of the terrestrial battlefield, and conflicts in space may indeed produce fewer casualties than extended conflicts on the ground. **SSQ**

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Currently president of the Space Strategies Center, the author has 46 years' experience in space and missile systems development for the United States Air Force, Army, Navy, and Marines. This includes outer space warfare theory, policy, doctrine, strategies, and tactics and techniques in addition to space battle management and war gaming, space situational awareness, space survivability/resiliency, and space predictive battlespace awareness. He has worked with the Air Staff at the Pentagon (Secretary of the Air Force, SAF/AQS), the Space and Missile Systems Center (SMC/ASP) in Los Angeles, and the Air Force Research Labs (AFRL/RV/RD/RI/RH) and has experience in operational field-testing of missile systems at China Lake, California. LinkedIn Profile: [www.linkedin.com/in/PaulSzymanski](http://www.linkedin.com/in/PaulSzymanski).

### **Notes**

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4. JP 5-0, *Joint Planning*, 16 June 2017, IV-23.

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6. View a detailed list of possible strategic, operational, and tactical space COGs in app. 2 of this article. The appendices for this article are available online only at [https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-13\\_Issue-4/SzymanskiAppendices.pdf](https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-13_Issue-4/SzymanskiAppendices.pdf).

7. In 1981, the author conducted a study of classical military principles of war (United States tri-service, British, and Russian) that were combined, summarized, and updated for

space warfare. The US Joint Chiefs of Staff commissioned this study when they were trying to decide whether to establish a Space Command or a Continental Defense Command.

8. The author developed these rules based solely on his 46 years' experience in this field.

9. Stated in discussion with author.

10. This rule was suggested by Paul Day, Space Command and Control Requirements Lead, Headquarters Air Force Space Command, Peterson AFB, Colorado.

11. See app. 3, "Space Glossary List," for definitions of the differing levels of space attacks. The appendices for this article are available online only at [https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-13\\_Issue-4/SzymanskiAppendices.pdf](https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-13_Issue-4/SzymanskiAppendices.pdf).

12. The appendices for this article are available online only at [https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-13\\_Issue-4/SzymanskiAppendices.pdf](https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-13_Issue-4/SzymanskiAppendices.pdf).

13. The author developed the information in this table 10 years ago.

14. JP 5-0, *Joint Planning*, IV-19–IV-20.

15. The complete list is in app. 1. The appendices for this article are available online only at [https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-13\\_Issue-4/SzymanskiAppendices.pdf](https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-13_Issue-4/SzymanskiAppendices.pdf).

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