Time
The New Dimension in War

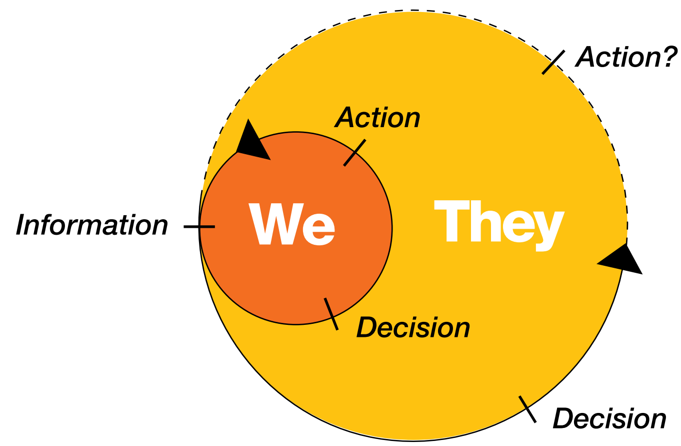
By AJAY SINGH

Success and failure in war—as in most human endeavors—rests on the ability or failure to create and exploit asymmetries in capabilities and action. These asymmetries result from a process of technological revolution and evolution, based on microrevolutions, and generalship that exploits them in time and space. Methods of warfighting undergo changes through microrevolutions that are usually driven by innovations such as the stirrup, crossbow, gunpowder, steamship, wireless, et al. A revolution in military affairs (RMA) occurs when there are essential changes in the nature of war requiring a reassessment of the way we plan and conduct warfare. This revolution displays a shift in the center of gravity of military activity. The common denominator is a growth in either mobility or firepower, or both, that increases the premium on time and space. Throughout history time and space have been played against each other to gain advantage in battle. With the passing of the years, time has gradually been compressed while space has expanded.

Squadron Leader Ajay Singh, Indian Air Force, is a fighter pilot assigned to Air Headquarters in New Delhi.

The pace of war has changed little over the centuries, and therefore warriors did not really experience the compression of time. With the advent of airpower, warfare expanded into a third dimension, and the process of creating asymmetry was lifted to a new dimension. Airpower thus constituted an RMA, the impact of which started to be felt with the end of World War I. Today we are at the threshold of new technologies which promise to enlarge the battlefield even more and shrink the time available for decisionmaking and action to critical levels. Their net effect—whether long-range weapons or information warfare technologies—will be to tighten the decision loop until an asymmetry created in time proves to be decisive. This new revolution can therefore be termed the advent of the fourth dimension—*time*.

IDA Cycle in "T time"



Note: The continuous line in the figure represents "T time" which is the time to complete the cycle. For an enemy, the time to complete the cycle is "T plus time" which leads to a time differential that causes a lag in its response with resulting adverse asymmetry.

Two-Dimensional Warfare

For centuries war was confined to two dimensions, breadth and depth. Combat at sea and on land remained limited to these two dimensions even as the area of battle expanded. Subsurface warfare at sea did not alter the basic dimension, although it did expand conflict in space. Advances in military technology primarily contributed to increased mobility and firepower in terms of depth and breadth. Many technological advances led to an impact on the methodology of warfighting and thus can be called microrevolutions. Their effect enhanced speed and lethality in battle, though the results were spread over time, perhaps centuries.

One early microrevolution was the expansion of the battlefield by cavalry. With enhanced mobility, forces could engage at longer ranges more quickly. This was the way in which Mongol cavalry swept across Asia. Another microrevolution was the stirrup, giving horsemen enhanced firepower on the move.[1] The English longbow and 10th century crossbow also caused changes in tactics. Gunpowder in the 15th century further increased firepower, while the grooved rifle which was fielded during the Civil War increased accuracy and further expanded the battlefield, although within existing limits of time and space.

The Industrial Revolution heightened the pace as well as intensity of combat, which led to greater lethality and to the industrialization of war. The tank, introduced in World War I, included elements of enhanced mobility and firepower in a single vehicle, although its real significance was not recognized until World War II when combat became even more violent. Armored warfare, however, was confined to the dimensions of breadth and depth, and continued to require the forces of one nation to defeat those of another to impose its will. Though many developments had taken place over the centuries, warfare remained tied physically to the surface (either on land or at sea), and was hence two-dimensional. It was the acceleration of technological changes beginning in the 20th century that led to a major revolution in the nature of warfighting.

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Third Dimension

The advent of airpower extended warfare into the third dimension, making it possible to target a nation—and its will—directly and thus conquer territory without destroying enemy forces. That began with the aerial bombardment from Austrian balloons during the siege of Venice in 1849 which led to calls for a permanent ban "on the discharge of any kind of projectile or explosive from balloons or by similar means" at the Hague in 1899.[2] While the ban was not adopted, destruction from the air clearly heralded a fundamental change in military affairs. Ten years before the flight of the Wright brothers, J.D. Fullerton of the British army's Royal Engineers spoke of a "revolution in the art of war" where "the chief work will be done in the air, and the arrival of the aerial fleet over the enemy's capital will probably conclude the campaign."[3] Other strategists such as Douhet and Mitchell elaborated on the concept later, but they were more prophets than strategists.[4]

Although forerunners of the third dimension recognized the impact airpower would have on war, technology did not mature in the earlier decades to a level where it had a revolutionary effect. It was a case where doctrine ran ahead of technology, giving rise to misgivings and skepticism. Much of the problem in understanding airpower even today is due to the fact that landpower and seapower doctrine is based on centuries of experience while airpower is only a hundred years old. But if our understanding of airpower has been clouded for these reasons, Fullerton's vision of the third dimension as a revolution in warfare has been amply vindicated over the last century.[5]

Airpower had developed sufficiently by World War I that it could be employed in combat. Between wars, it matured enough to contribute substantially in World War II, and warfare in the surface medium (including subsurface) could not keep pace with changes in the third dimension. The maturing of technology in World War II facilitated use of doctrine envisioned in earlier years. One classic example of the revolutionary impact of airpower was the *Blitzkrieg* concept, where dive bombers leading *panzer* thrusts rapidly destabilized and disrupted defenses into defeat.[6] The Battle of Britain changed the course of the war itself, resulting in the cancellation of German plans for the invasion of England. The ability of airpower to target surface forces from the third dimension was an influence on the surface battle, especially in the North African campaign.[7] Besides its offensive employment for destruction, the third dimension airlifted troops and materiel, thus enhancing the mobility of surface forces by air transport or airborne operations. Creating major asymmetries in time and space by exploiting the third dimension literally lifted traditional two-dimensional warfare to nonlinear dimensions. The struggle to control the third dimension itself became a major military aim.[8] Strategic bombing may not have achieved the expected objectives, but the atomic bombing of Hiroshima finally established what the prophets had forecast.

The intensity of the revolution continued into the nuclear age, with significant advances in levels of technology. The most obvious fallout in the post-war era was a total shift in the currency of power to the third dimension through nuclear weapons that were air deliverable. The increased use


AWACS.

U.S. Air Force

of the electromagnetic spectrum and a move toward more accurate aerial weapons profoundly affected warfighting. Though the electromagnetic spectrum was significant during World War II, its exploitation matured in Vietnam when precision guided munitions (PGMs) made an operational appearance. The maturing of electronic warfare is a microrevolution in military affairs and a subset of the third dimension since it is primarily conducted through, for, and against activities in the third dimension.[9] While PGMs provide greater accuracy and timeliness, they must be backed through reconnaissance, surveillance, and target acquisition (RSTA) technologies to be effective. Increased military use of space has led to a scenario of space-based weapons and defenses. A move toward continuous asymmetry above the earth was evident in the SDI technology of the Reagan era.[10]

The last hundred years of warfare in the third dimension has clearly shown that airpower (including space) has fulfilled its promise of being a true revolution. It is dominant in combat; and while it may not achieve victory alone, airpower is nevertheless essential to winning a war. Even in Vietnam it was not that airpower failed as some claim; it was an ill-defined threat combined with unclear political objectives that fettered the third dimension. Airpower remained critical as seen in the defense of Khe Sanh or in Linebacker II.

Around the same time, the Arab-Israeli war proved that airpower had the potential to decide the outcome of surface war. In the 1982 Bekaa Valley operations, Israel used the third dimension in a decisive manner.[11] This was repeated by the U.S.-led coalition in the Persian Gulf War, albeit on a larger scale. This was also perhaps the first war when information was employed extensively to create conditions conducive to victory. Satellites provided real-time information to operational commanders. U.S. Space Command assets were critical for cuing Patriot batteries. Time was of importance in such missions and all efforts were made to obtain real-time information, whether for targeting Scud launchers or battlefield targets. This war was the first where real-time information was a reality, and the results indicated that the time had come for it to play a crucial role in combat. While the coalition benefitted from compressed time-cycles, Iraqi time-cycles had distended to such a degree that they became totally irrelevant. This war was for all practical purposes a combination of the potency of the third dimension and the use of sophisticated technology to shrink the time for decision-action synergy. To that extent, this war was the overlap in which signs of another RMA could be seen—the advent of the fourth dimension of war.

Fourth Dimension

The nature of the battlefield is undergoing transformation. Fully automated warfare may be technologically feasible in the next twenty years.[12] Airpower has provided a dynamic platform for change. Its early signs were apparent in the Bekaa Valley where nonlinearity from technological advances helped to destroy Syrian forces at the front and to stop the Syrian 3d Armored Division in its tracks before it reached the battle. The doctrine was incorporated in the AirLand Battle concept, which spoke of an extended battlefield where airpower would engage follow-on forces and enemy targets in depth. During the Gulf War the indications were much clearer that future conflict would involve extensive use of technology to conduct the battle at extended ranges and compressed time. With further advances in technology, the battlefield can be expected to expand even more. Hitting targets at long range with precision RSTA technologies is critical and translates into the accuracy and time sensitivity of information. While accuracy is a matter of acquisition and guidance sensor technologies, time on the expanded battlefield needs greater attention. Technologies of the future may provide highly accurate information which satisfies needs on all levels of war, although if it is not timely it could be worthless. The result will be a new dimension—time—which promises to envelop the other dimensions of war as a force multiplier and counterforce divider.

time promises to envelop the other dimensions of war as a force multiplier

Although time has always been a factor in war, technology has never been at a stage where it could play an independent and dominant role in shaping conflicts. The slow pace of war when it was confined to two dimensions also meant that the human decisionmaking loop was never pushed to its time limits by the demands of battle management. It was not that time did not play a key role; rather, the advantage offered by timely information was often overshadowed by the relatively large time required to act on it. Notwithstanding this, time has always been crucial to surprise.[13]

Reorienting the IDA Cycle

With the inherent mobility and firepower of airpower, the expansion of war to the third dimension largely changed the factor of time. The dimension of time began to be recognized as more important, and conscious efforts were made to reduce the time required to gather information, disseminate it, make a decision, and follow it up by action. In the 20th century, rapid technological advancement has reduced the span needed to know, decide, and act with the result that time has been shrinking, while space (the extent of the battlefield) has been expanding. This may lead to a state of seamless space, where borders become even less relevant in the conduct of war, and time assumes the form of boundaries. This border of time will be the decisive factor of war and will call for orienting the information-decision-action (IDA) cycle in terms of time.

The IDA cycle is a basic element of the dimension of time in military affairs and represents a set of activities required in all of them. The size of the loop is a demonstration of the time taken to achieve a specific task. The faster this cycle is completed, the greater the compression of time. The aim, when operating in this dimension, is to shorten the cycle as much as possible and thereby retain the advantage of time over an enemy. It is important to understand that each component of the cycle has its own subcycles and, accordingly, the time needed for a given task is the sum of the time required to complete each of the subcycles and the overall cycle itself.

Some tasks may call for completing a number of cycles before the action reaches finality. The time dimension will then be that much more dilated compared to single-cycle tasks. The IDA cycles required for a particular task, such as neutralizing a target system, depend on the nature of that system—the vulnerability and recuperability of subsystems, and the accuracy and effectiveness of one's own decision and action components of the IDA cycle. The probability of a single-cycle task is very low, considering that some cycle overrun would be needed for a reasonable degree of assurance of task achievement. But the objective clearly must be the reduction of the number of cycles required for a particular task, as close to unity as possible, along with compression of each cycle (time), since the total term taken would be the sum of all cycles.

One method of achieving this would be identifying the weak links in the IDA cycle, then incorporating appropriate solutions to strengthen the cycle, or in other words reducing the subcycle or cycle time. The solution selected could, depending on the problem area, be based on improving procedures or technological modifications or innovations. The rule of the chain applies here—that is, the strength of the cycle in terms of time will often be only as strong as the weakest link of the cycle (again in terms of time). Delays in one segment, therefore, may well be the deciding factor. Conversely, degradation of hostile IDA cycle, based on identifying weak or vulnerable positions of the cycle and attacking it at a faster pace than it can recuperate, could prove decisive in one's favor. For example, targeting Saddam's command and control functions led to an asymmetry where his IDA cycle was totally degraded in the early hours of the war, and he was incapable of responding in a meaningful time-frame, though other components of military power were available. Another example is planning airfield denial missions by designing their frequency to stay within an enemy's airfield rehabilitation ability in terms of time. A striking case of time versus time is the frequency-hopping technique used by radars as an electronic counter-countermeasure in a race in the fourth dimension, against the effects of hostile electronic countermeasures.

Of the advances underway, the most significant are in the information segment of the cycle. In fact, this segment is technologically more dependent than the others, and thus the payoffs are likely to be much greater. This has been recognized by many experts, some of whom have called information a new revolution in war. While the role of information in the time dimension deserves special attention, it must be recalled that information is merely a means to an end, not an end in itself. It must be seen as part of the overall IDA cycle, although a critical component of the fourth dimension. Information warfare involves using information to one's advantage and also denying its benefits to an enemy. Under close scrutiny, therefore, information entails degrading, delaying, and disrupting information to confuse an enemy and increase response time. The greatest change in the information campaign over the years has been the expansion of the quantum of information which can be made available and the contraction of processing time (a microrevolution in itself).

The speed and volume of information, although an asset in the fourth dimension, can create vulnerabilities. Even with reduced processing time, there is a possibility of information overload, creating congestion and delays in using information. Thus there will be an inescapable need for the information to be time-sensitive. The amount of data processed will be greater than the processing power of the information system and, therefore, information technology application in combat has become more susceptible to the time factor. And since it is actually a subset of the IDA cycle, it is correct to term the advances in information technology as incremental to the criticality of the time dimension, hastening the advent of the fourth dimension as a true RMA.


M–1 Abrams.

U.S. Army

Targeting Time Cycles

Had Saddam Hussein thought in the fourth dimension, he might have realized that the only chance that Iraq had of success was the disruption of the coalition build-up during Desert Shield, which offered a window of vulnerability as the allies mobilized. The point was not whether Iraq could have defeated the coalition in battle, but recognition that the war would have followed a different course if the fourth dimension had been exploited. The coalition did control and exploit it to a certain extent, as seen in the interception of Scud missiles, which would otherwise have been extremely difficult. It is worth noting that after the war the Pentagon initiated programs such as the Joint Precision Strike Demonstration Task Force (JPSDTF) to reduce sensor-to-shooter timelines. The goals of JPSDTF include reducing timelines, now measured in hours, to two minutes.[14] This is a clear recognition of the impact of the fourth dimension in warfighting. In fact, the question of ballistic missiles being a destabilizing factor is essentially linked to the fourth dimension, as these missiles, especially short range ones, do not give the IDA cycle of the defender adequate time to mount a response even if the means exist. Tightening the cycle beyond reasonable human control was no doubt a major factor that led to the intermediate nuclear force treaty since vulnerabilities on both sides increased inversely to the tightening of the cycle dictated by the missiles. The first step in defending against the missile threat thus lies in the fourth dimension as any anti-missile defense system designer must recognize. SDI did this by developing technologies that promised to reduce the time needed for early warning and boost-phase/mid-course interception. The Soviet objections to SDI also resulted from the implicit adverse asymmetry of the relative IDA cycle.

As airpower demanded airpower to counter it, so will the new dimension of time require its war to be fought in the fourth dimension. Just as air superiority was a prerequisite to successful warfare in the third dimension, freedom of action and control of the fourth dimension will become necessary to operate on future battlefields. This will lead to the targeting of time cycles to degrade an enemy cycle, while safeguarding one's own from enemy interference. The objective of causing an asymmetry in this dimension will demand thought and action to create a time differential where the

IDA cycle for an objective on any level of war starts and finishes before the response time or enemy IDA cycle. If one completes the cycle in "T time," forcing an enemy to complete its cycle in "T-plus time," one creates a time differential. In other words, to conduct time warfare one must stay within the enemy IDA cycle, thus gaining control of the fourth dimension. Only with control of time can one exploit this dimension and subsequently fight in other dimensions. If control of time is lost it is likely to pass on to the other side, and the side which loses the race for control of the fourth dimension will find itself continuously sliding down in its time cycles. Recovery may be made difficult by a domino effect influencing current and future cycles. The side that controls time will be in a superior position to conduct war in all dimensions.

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Centuries of conflict have proven that offensive action provides the greatest control in any dimension of warfare, and time is no exception. In fact, considering the potentially destabilizing nature of time warfare, the fourth dimension favors the offensive more than any other dimension. Traditional military organizational structures may require redefinition to suit demands of war in the new dimension to pass the litmus test of a small IDA cycle. Plans must ensure that nodal points, vulnerable to enemy interference, are kept to a bare minimum. Hardening organizational structures against interference should be done using physical and software solutions to provide counterforce dividers. At the same time, the ability to create friction must exist to degrade enemy IDA cycles.[15] Integrating technologies—artificial intelligence, JTIDS, JSTARS, AWACS, et al.—is fundamental to the reorientation of military structure.

In the future a number of countries are likely to reduce their IDA cycles, enabling them to fight in the fourth dimension. It is hard to see a serious challenge to the United States on the global level for the next quarter century. Only Japan has the requisite technological strength. But intent is another matter altogether. Although Russia now lags in fourth dimension technology compared to the United States and Japan, it can be expected to catch up. At the regional level, however, the key question that U.S. forces will confront is whether they have sufficient power in place to counter a belligerent able to exploit the fourth dimension. If not, they may be threatened by the dynamics of the IDA cycle before reinforcements can be deployed. Between other states, the conflict would be shaped by the relative capabilities of sides in the fourth dimension and how these are exploited.

Of all emerging technologies, the most significant impact on the fourth dimension may be the trans-atmospheric vehicle (TAV). This technology will make it possible to rapidly launch small satellites to provide cover of an area in the event of the regular sensors being incapacitated through antisatellite warfare, which is expected to increase as reliance on the sensors grows to cut down the IDA cycle. TAV can also be employed in an antisatellite role since it will provide a highly accurate, flexible, and low-IDA cycle option with on-board directed and kinetic energy weapons. Thus the impact of the fourth dimension is likely to increase exponentially based on the capability of TAV which, flying at a speed of Mach 30, will be able to target a point on the surface of the earth from its ground station in thirty minutes. It will therefore become virtually impossible to think without operating in the dimension of time when planning and conducting war. JFQ

NOTES

[1] R. Ernest Dupuy and Trevor N. Dupuy, *The Encyclopedia of Military History* (London: McDonald, 1970), p. 137.

[2] Jasjit Singh, "Evolution of Politico-Military Doctrines," in Jasjit Singh and Vatroslav Vekaric, editors, *Non-Provocative Defence* (New Delhi: Lancer Press, 1990), pp. 17–18.

[3] David MacIsaac, "Voices from the Central Blue: The Air Power Theorists," in Peter Paret, editor, *Makers of Modern Strategy: From Machiavelli to the Nuclear Age* (Princeton: Princeton University Press, 1986), p. 627.

[4] Giulio Douhet, *The Command of the Air*, translated by Dino Ferrari (New York: Coward-McCann, 1942), pp. 11–16.

[5] Tony Mason, *Air Power: A Centennial Appraisal* (London: Brassey's, 1994).

[6] Harold Faber, *Luftwaffe: An Analysis by Former Luftwaffe Generals* (London: Sidgwick and Jackson, 1979), p. 165.

[7] J.F.C. Fuller, *The Second World War, 1939–1945: A Strategical and Tactical History* (New Delhi: The English Book Store, 1969), pp. 220–59.

[8] Jasjit Singh, *Air Power in Modern Warfare* (New Delhi: Lancer International, 1985), pp. 1–33.

[9] Some regard electronic warfare as the fourth dimension; Ibid., pp. 122–37.

[10] Simon P. Warden, *SDI and the Alternatives* (Washington: National Defense University Press, 1991), pp. 159–60.

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[13] Richard E. Simpkin, *Race to the Swift: Thoughts on 21st Century Warfare* (London: Brassey's Defence Publishers, 1985), pp. 182–84.

[14] John Boatman, "Army Plans Two-Minute Warning," *Jane's Defence Weekly* (June 17, 1995), p. 27.

[15] Carl von Clausewitz, *On War*, Anatol Rapoport, editor (London: Penguin Books, 1968), pp. 164–67.

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