Strategy Research Project

Twenty-First Century Defense and Disruptive Innovation

by

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TWENTY-FIRST CENTURY DEFENSE AND DISRUPTIVE INNOVATION

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TWENTY-FIRST CENTURY DEFENSE AND DISRUPTIVE INNOVATION

> Victory smiles upon those who anticipate the changes in the character of war, not upon those who wait to adapt themselves after the changes occur.
>
> —Giulio Douhet[1]

The U.S. military is the most sophisticated and technologically superior force in the world. The strength of the American economy and the immense capability of the defense industry over the past sixty-five years underscore this fact. The economic ability to invest in "hi-tech" innovation and ingenuity has been just as critical as the industry's ability to sustain the pace of change in the force. Yet the past ten years of war has illustrated that being technologically superior is not enough to defeat determined armed terrorists. Some of the Nation's most expensive and sophisticated weapon systems have been irrelevant in winning the fight against an asymmetric threat. This fact, coupled with the decline in the economy, suggests that technological supremacy is not the only avenue in meeting future threats to national security.

While the U.S. military must be able to accomplish its primary mission of fighting and winning our nation's wars in the air, sea, and land domain, it must not ignore disruptive innovations. The military tends to focus on incremental improvements to existing technologies or sustaining innovations, because these support its primary mission and doctrine, and require the greatest commitment of resources; this tendency is even more pronounced in peacetime.[2] However, precisely because the U.S. is the global leader on land, sea, air, and beyond, adversaries are likely to threaten the U.S. in ways that seek to circumvent these advantages, instead of challenging them directly.

The theory of disruptive innovation offers a framework for understanding how and where such threats are likely to emerge. It also suggests that the development of requirements and the management of acquisitions within the conventional system are unlikely to anticipate these threats. Disruptive innovations are often viewed as radical challenges to existing technologies. This is misleading. Disruptive technology is defined not by the nature of the innovation itself, but by the way in which dominant organizations mismanage technology that eventually becomes a mortal threat. Disruptive innovations initially fail to meet the requirements of an organization's core customers (or mission, in the case of the military);[3] this results in underinvestment in (or a complete rejection of) the technology. Trailing organizations (or nations)—those not captive to the dominant paradigm—are more likely to find applications where disruptive technologies meet different requirements. This paper recounts this dynamic through the example of the disk drive industry in the U.S. (the inspiration for Christensen's theory). The model of disruption predicts that leading organizations will fail to properly manage disruptive technologies. Thus, disruptive military technologies are likely to be ignored by the U.S. military, even more so in a resource constrained environment.

Yet the U.S.'s management of unmanned aircraft systems (UAS) over the past decade would seem to offer a powerful counterexample to this prediction. As discussed below, UAS have many of the characteristics of disruptive technology. As of September 11, 2001, in maneuverability, speed, payload, etc., unmanned aircraft failed to meet the requirements of core air missions of the Navy, Air Force, Army, and Marine Corps. Yet contact with the enemy in Afghanistan, Iraq and elsewhere increased the importance of missions for which UAS were particularly well-suited—missions with

significant persistence and battlespace awareness requirements. This drove major new investments in unmanned platforms, after years in which UAS had languished. As a result, unmanned aircraft are now on a trajectory of long-term, sustaining innovation in which they are likely to supplant manned aircraft in numerous other areas, including ground attack and air superiority in non-permissive environments.

In preparing for future wars, the U.S. military must anticipate new threats. The successful management of disruptive technologies is crucial to this preparation. This paper explores the military's management of innovation in acquisitions. It has three objectives. First, it outlines how the existing acquisitions system is geared to the successful management of sustaining innovations (the definition of which is discussed below). Second, it seeks to understand how, in the case of UAS, the U.S. military successfully overcame the obstacles that typically bedevil leading organizations in the management of disruptive technology. Finally, it examines the applicability of the lessons of the military's management of UAS in the post conflict era, and the inherent difficulty of replicating this experience in other disruptive technologies. Arguably, without the impetus of war, the unmanned aircraft would still number in the hundreds and would only fill a small niche instead of disrupting the way we prosecute wars today. What lessons should we learn from this experience?

Models of Innovation

Innovation is the development of new ideas, methods, or processes.[4] Professor Clayton M. Christensen, author of the best-selling book, *The Innovator's Dilemma,* posits a stimulating theory on this topic. His analysis of several top companies illustrate that "leading companies failed when confronted with disruptive changes in technology".[5] His research revealed these firms were not successful because of poor administration,

on the contrary, “good management was the most powerful reason they failed.”[6] This is the dilemma and subject of much debate in his book and provides great insight for military acquisition.

Professor Christensen describes two categories of innovation: sustaining and disruptive. Most new products that are developed focus on improved performance to something that already exists in a market. This is what Christensen refers to as a sustaining innovation. Top companies study markets and invest their money in what promises to deliver the best returns.[7] These innovations can be both radical and incremental. This type of innovation is where the defense industry is extremely proficient. They understand customer needs and they target known markets by constantly improving existing products to beat future adversaries. They create better tanks, planes, and ships to meet the needs of soldiers, airman, and sailors. Sustaining innovation is a natural approach for an industry focused on technological dominance but at the same time leads to blind spots. Christensen emphasizes there are occasions where “it is right not to listen to customers…and right to aggressively pursue small, rather than substantial, markets.”[8] This is disruptive innovation and the path that lead to the success of unmanned aircraft. This approach, however, is much harder to manage in a system designed to do the opposite.

Christensen first introduced the theory of disruptive innovation in 1996. A disruptive innovation is an innovation that helps create a new market and value network, and eventually goes on to disrupt an existing market and value network (as will be described below), displacing a previous technology. He studied how top well-managed business companies fail because of disruptive innovations. He explains that these top

companies were extremely proficient and profitable at sustaining technologies but not with disruptive. This failure ultimately resulted in their downfall. Since disruptive technologies fail to meet mainstream customer expectations and typically underperform in the mainstream market, top companies normally do not view them as a viable product in their value network. Other organizations, however, recognize their value in other markets and are able to exploit them. This is the nexus of the problem outlined by Christensen and is an inherent problem in the defense acquisition system. Christensen focused much of his research analyzing the disk drive industry to illustrate this dilemma.

Disruptive Innovation – Disk Drive Industry

The history of the disk drive industry presents an interesting example of how quickly technology changes and the impacts that occur as a result. He chose to study this industry based upon the advice of a colleague:

> Those who study genetics avoid studying humans…because new generations come along only every thirty years or so, it takes a long time to understand the cause and effect of any changes…Instead they study fruit flies, because they are conceived, born, mature, and die all within a single day. If you want to understand why something happens in business, study the disk drive Industry. Those companies are the closest things to fruit flies that the business world will ever see.[9]

His in depth study determined why top companies were failing despite their previous record of success.

IBM's San Jose research laboratories invented disk drives back in the 1950s to read and write information used by computers. The drive was the size of a refrigerator with a series of twenty-four inch disks that stored a massive 5 megabytes (MB) of information. As computers evolved, the independent disk drive industry arose and by 1976, this industry was producing $1 billion worth of disk drives each year and had seventeen firms competing in the market. By 1996, IBM was the only disk drive

company that remained.[10] These statistics were intriguing and encouraged Christensen to determine the root cause of this phenomenon.

The disk drive industry focused on the architectural innovations that shrunk the size of the drives. The baseline disk drive in the 1970s was 14 inches in size and held roughly 100 MB of information. Through the 1990s, they shrunk in size from 14 to 8, 5.25, 3.5, 2.5 inches and culminated at 1.8 inches. These changes were technologically straightforward but each successive drive was simpler than the previous. The smaller drives initially offered less of what mainstream customers wanted, storage capacity, and therefore did not appeal to the existing market. The industry leaders could not see the value in these smaller drives since they did not meet the minimum demand of the current market. Analyzing one of these disruptive events will demonstrate this point.

In 1974, the 14-inch disk drive was the standard size designed for the mainframe computer market. Between 1978 and 1980, several new firms introduced a smaller 8-inch drive. The initial 8-inch drives held a maximum of 40 MB of information but the mainframe computer market required 400 MB. The leaders in the 14-inch disk drive industry compared these new drives to the requirements of their existing customer base and did not adopt the technology. They did not recognize the value in this smaller, cheaper, and less capable drive, and dismissed their potential. The new firms, however, were not held captive by customer demands and were able to seek out new markets that would accept them. They found it in the emerging minicomputer market where the smaller size and overall cost was valued over the data storage capacity. As these new disk drive companies invested in the smaller drives and improved their products with greater storage capacity, the 8-inch disk drive began to appeal to the mainframe

computer market. The smaller drives with lower overall cost became the new value market. Once the value market changed, the established firms of the 14-inch drive began to fail. Ultimately, the new 8-inch disk drive companies forced all of the 14-inch drive firms out of business. This trend repeats itself as new companies developed smaller disk drives that appealed to other emergent markets from desktops to notebooks and notebooks to personal data assistants. Figure 1 visually demonstrates this market phenomenon where the disruption exists at the intersecting lines.

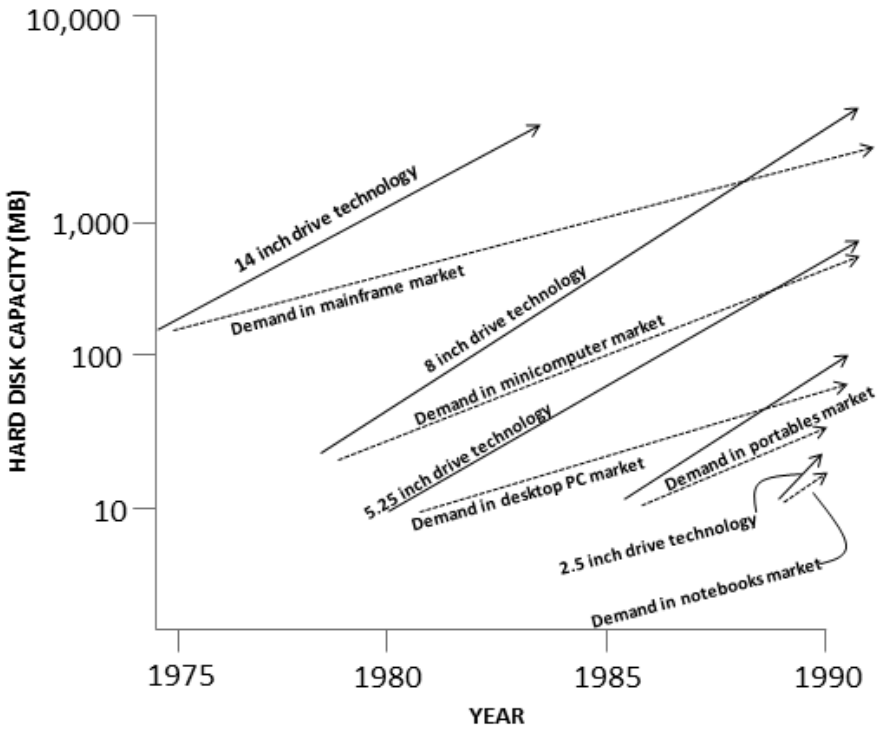

Figure 1. Intersecting Trajectories of Capacity Demanded versus Capacity Supplied in Rigid Disk Drives[11]

Unlike the disk drive industry, disruptive innovation is not likely to put the defense industry or U.S. military out of business. The significance of disruptive innovation is the likelihood of our adversary to use it against us. Just as the 14-inch disk drive firms failed to recognize the value of the 8-inch disk drive, that same blind spot exists in our military

today. Although ten years of war fostered an environment that accepted disruptive innovation, the permanency of this change is not clear.

Sustaining Innovation – Defense Acquisition System Case Study

The existing acquisitions system is geared to the successful management of sustaining innovations. When weapon systems and equipment fail to satisfy the demands of the warfighter, the defense industry mobilizes to correct this problem. The defense acquisition system is designed to meet customer needs, in this case the service member. It strives to "acquire quality products that satisfy user needs with measurable improvements."[12] It's what the system is designed to do best and little has changed from its inception following World War II.

As the United States recovered from national industrial mobilization following the war, there was a necessary shift from a mass production method to a consumer driven process focused first on the monolithic Soviet threat during the Cold War to a capability-based system that exists today. For the last sixty-five years, the acquisition system became extremely competent in "evolutionary acquisition strategies…to satisfy operational needs."[13] This strategy is responsible for creating the strongest and most technologically advanced military in the world.

In this approach, every weapon system in the U.S. military is intended to satisfy a requirement, paid for by the federal budget, and designed and built within the system.[14] Sustaining innovations simply refine the way we do business and allow us to do it better. Disruptive innovations, on the other hand, change the business altogether. There are merits to each but the tendency of the military method favors the sustaining approach and attempts to capitalize on a good return on investment. Equipment modernization is a prime example of a typical sustaining approach. The evolutionary

modernization of the helicopter presents an ideal case study of how successful this approach works.

Helicopters played a rather insignificant role during World War II but they gained momentum at the beginning of the Cold War. It wasn't until the Korean War, however, that helicopters were fully adopted into the doctrine as a viable military solution for operations in austere rugged terrain. Initially limited in size and power they followed an evolutionary path in innovation that lead to their more prominent role in Vietnam. Thanks to sustaining innovations, the Army grew from 57 helicopters in 1950 to 800 in 1954 to well over 9500 by 1970.[15] It was successful sustaining innovations that caused this explosion and demonstrates how the traditional acquisition system is designed to serve military needs. The helicopter had several sustaining innovations that enabled their survival including improvements to the engines, transmission, and rotor system.

In 1952, during the Korean War, the Army identified the requirement for a new helicopter that could carry more people and fly further and faster. Bell helicopter won the contract and used the lessons from the H-13, the helicopter famously known for its role in medical evacuation, and focused on improving this platform. The HU-1A (original Army designation) was the result. Bell essentially received input from its customers with the Korean War experience and improved the H-13 design. The result was an aircraft with a troop cabin, powered by a larger engine with an improved transmission and rotor system to allow it to fly further and faster. In 1960, after a proven prototype was built, Bell was awarded the contract to build 100 more. From the first delivery in 1960 through 1966, Bell modified the engine six times, increased the cabin size three times, and improved the rotor system twice. By 1974 the air mobility doctrine was a proven concept

and the replacement for the UH-1 was underway. In 1976 Sikorsky Aircraft Company won the contract to improve the utility helicopter to meet the growing demand and by 1979 the UH-60A Blackhawk was delivered to the field. Through the same acquisition process as the UH-1, it received upgrades to improve mission effectiveness over the course of the next twenty years and remains in service today. The chart below reflects the major sustaining innovations to the utility helicopter fleet over the course of the last sixty years.

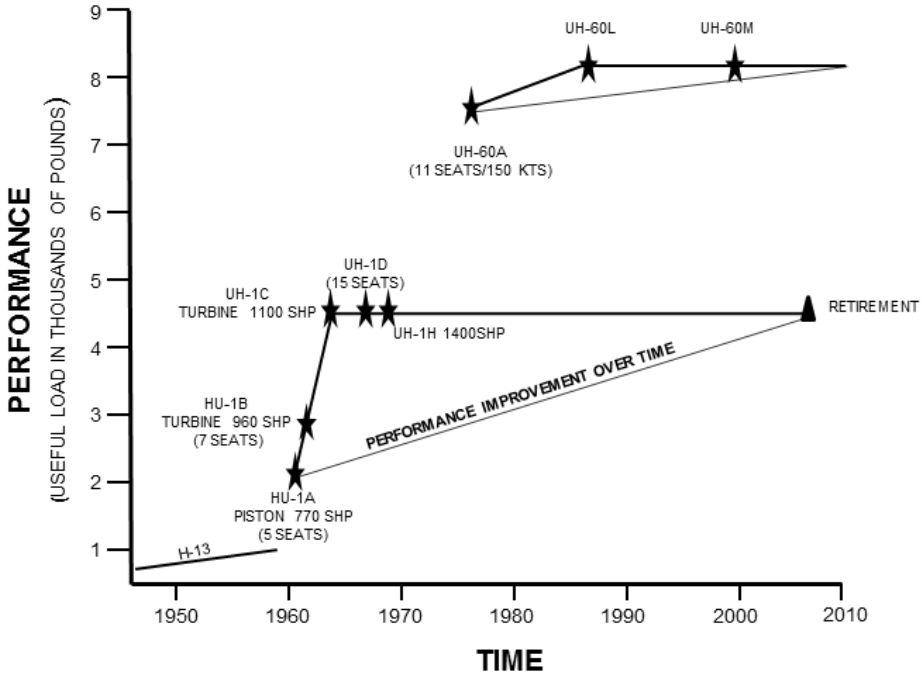

Figure 2. Utility Helicopter Sustaining Innovation Graph[16]

This sustaining approach reflects much of how acquisition works today, it rewards performance and fails to challenge the status quo which could lead to the U.S. ignoring disruptive military technologies, even more so in a resource constrained environment. The acquisition system must be able to capitalize on both sustaining and disruptive approaches in a future resource constrained environment in order to remain a

superior military force. The U.S.'s management of UAS offers some hope that we are capable of adapting. UAS acceptance and integration in the last decade represents a counterexample to the traditional acquisition system. Due to contact with the enemy, the military was able to do successfully adopt a disruptive technology while it still invested in sustaining innovations.

Disruptive Innovation – Unmanned Aircraft Case Study

Today unmanned and manned aircraft perform similar roles. Where manned aircraft once dominated the skies in the reconnaissance, surveillance and target acquisition roles, now unmanned aircraft are the tools of choice. This has not always been the case. Early unmanned aircraft didn't appeal to the mainstream military – manned aircraft could simply do it better.

The term unmanned aircraft is currently used to describe "an aircraft or balloon that does not carry a human operator and is capable of flight under remote control or autonomous programming."[17] UAS refers to the "system whose components include the necessary equipment, network, and personnel to control an unmanned aircraft."[18] Throughout its history the terms pilotless vehicle, drone, remotely piloted vehicle (RPV), and Unmanned Aerial Vehicle (UAV) were used to describe this technology which stretches back over 100 years. This case study will focus primarily on recent breakthroughs with a brief history of its evolution.

While the modernization of the helicopter illustrates how well the military improves existing products, the unmanned aircraft illustrates how it struggles with the disruptive ones. Warfare often changes these factors since there is often more willingness to accept greater risk to resolve military problems when human lives are at stake. This is the case for unmanned aircraft as well. Throughout its short history, both

crises and war seem to advance its abilities whereas the periods in between its growth remained stagnant. The most recent wars in Afghanistan and Iraq have seen the greatest advances in this disruptive technology and changed the way we fight now and into the future.

The recent conflicts in Afghanistan and Iraq have proven to be the “tipping point” for the unmanned aircraft market as well as the way we view acquisition in general. Major General Jack Brown, deputy for Acquisition and Systems Management in the Office of the Assistant Secretary of the Army for Acquisition, Logistics, and Technology, stated to industry leaders last year “mixing traditional acquisition practices with rapid and hybrid approaches is the best way the Army's acquisition community can serve Soldiers at war.”[19] This modified process truly makes the development and acceptance of disruptive technologies more likely. When the military is “in the fight” it’s constantly performing its primary mission and consequently identifies significantly more capability gaps than during peacetime. This is the nature of warfare and highlights why unmanned aircraft have taken so long to emerge. Developing and experimenting with disruptive technologies in peacetime against perceived threats is not easy but during war there’s constant experimentation that facilitates greater innovation and ingenuity. The Vietnam War illustrates this point with unmanned aircraft development.

Although unmanned aviation has its roots in the 19th Century unmanned aircraft didn’t truly find their place until Vietnam. The war in Vietnam represents the first significant breakthrough of unmanned aircraft entering into the domain of manned aircraft. Although short lived this is one example of how the demands of warfare and needs of the war-fighter influence innovation. Reconnaissance over Vietnam and other

parts of Indochina were extremely dangerous and the political ramification of losing a manned aircraft in an adversary's country was too risky. The unmanned aircraft, developed out of a target drone, found its niche in the manned reconnaissance domain by performing these sensitive and inherently dangerous missions. As these drones progressed, its roles were expanded to include electronic intelligence (ELINT) of surface to air missiles sites, battlefield damage assessments of the Vietnam bombing campaign, and communications intelligence (COMINT). It was constantly employed in hostile areas under poor weather conditions too dangerous for manned aircraft. It filled an important niche that other manned platforms were forbidden to perform. Similar to most disruptive technologies, performance fell well short of that of manned platforms. Reliability, accuracy, and quality imagery problems resulted in little advocacy and by war's end the restructuring of the military and fiscal constraints forced their retirement in 1975.

The Persian Gulf War in 1990-1991 would see a resurgence of interest in unmanned aircraft development. The Pioneer and Hunter, both Israeli designs, were adopted during the military buildup to meet the immediate needs of the warfighter. Their limited but notable success during this conflict once again rekindled the relationship between the military and unmanned aircraft. The roles it played in battlefield reconnaissance, surveillance and target acquisition, however, failed to achieve the momentum to force its adoption into military doctrine.

The 1990s proved to be a little more productive in terms of unmanned aircraft capabilities. The development of the internet, global position satellites, communications networks and precision weapons and sensors provided an opportunity for an unmanned aircraft revival. These breakthroughs coupled with the 1994 Balkan conflict catapulted

unmanned aircraft, specifically the RQ-1 Predator, back into the reconnaissance role. This time with their advanced navigations systems, sensors, agility, and persistence they were able to fill the intelligence collection void between satellites and manned reconnaissance platforms. Despite its success, however, their acquisition proved to be a slow process and still lacked significant advocacy. On September 11, 2001, only 167 unmanned aircraft existed within the Department of Defense but this quickly began to change.[20]

Currently unmanned aircraft are clearly disrupting manned aircraft in the intelligence, surveillance and reconnaissance market. Contact with the enemy in Afghanistan, Iraq and elsewhere increased the importance of missions for which the UAS were particularly well-suited—missions with significant persistence and battlespace awareness requirements. This drove major new investments in unmanned platforms, after years in which they had languished. As a result, UAS are now on a trajectory of long-term, sustaining innovation in which they are likely to supplant manned aircraft in numerous other areas, including ground attack and air superiority in non-permissive environments.

Unmanned Aircraft Today

Today unmanned aircraft are on the cusp of taking the place of manned aircraft in not only the intelligence, surveillance, and reconnaissance roles but other areas as well. Although each of the Services continues to manage their separate systems, the Department of Defense maintains oversight. The Unmanned Systems Roadmap 2011-2036 is the tool it uses to project current and future growth expected across the Services and provides certain areas where UAS are expected to dominate. In the acquisition environment all systems must fit inside a Joint Capabilities Areas (JCA). This

defines what roles each major system is expected to fill. There are a total of nine Tier 1 JCAs that categorize weapon system integration in this process: (1) Force Application, (2) Command and Control, (3) Battle Space Awareness, (4) Net-Centric, (5) Building Partnerships, (6) Protection, (7) Logistics, (8) Force Support, and (9) Corporate Management and Support. Unmanned aircraft are forecasted to contribute to four of these areas - Battle Space Awareness, Force Application, Protection, and Logistics - which implies they could assume the role of manned aircraft that perform the same mission.[21] Battle Space Awareness refers to intelligence, surveillance, reconnaissance and collection management requirements. Force application refers to maneuver and engagement. Protection focuses in on preventive measures to protect the force. Logistics refers to the tasks related to deployment, distribution, and supply. The chart below outlines current and future implications for unmanned aircraft to support of these areas.

JCA	MISSION	UNMANNED VEHICLE	*MANNED VEHICLE
BATTLESPACE AWARENESS	ISR, TARGET ACQUISITION	PREDATOR, REAPER, GRAY EAGLE, GLOBAL HAWK, BAMS	RC-135, RC-10, RC-12, RP-3, F16, F18, F22, F35, RC-35
FORCE APPLICATION	STRIKE/AIR COMBAT	N/C	N/C
PROTECTION	CSAR, SECURITY, MARITIME INTERD.	MAV, RAVEN, SHADOW, PREDATOR, REAPER, GRAY EAGLE, FIRE SCOUT, PTDS	AH-64D, OH-58D, HH-60
LOGISTICS	RESUPPLY/REFUEL	PROTOTYPE – KMAX	UH-60, CH-47, V22 KC-135, C130, C17
*Not all inclusive			

Figure 3. Comparison of Joint Capabilities Area for Unmanned Aircraft[22]

Similar to the disruption in the disk drive industry, unmanned aircraft are beginning to disrupt manned aircraft in certain areas. The metrics for unmanned aircraft include

payload, persistence, and overall cost. In some of the JCAs such as Battle Space Awareness UAS already play a dominant role over manned aircraft but logistics remain immature. This phenomenon is captured in Figure 3 above and 4 below:

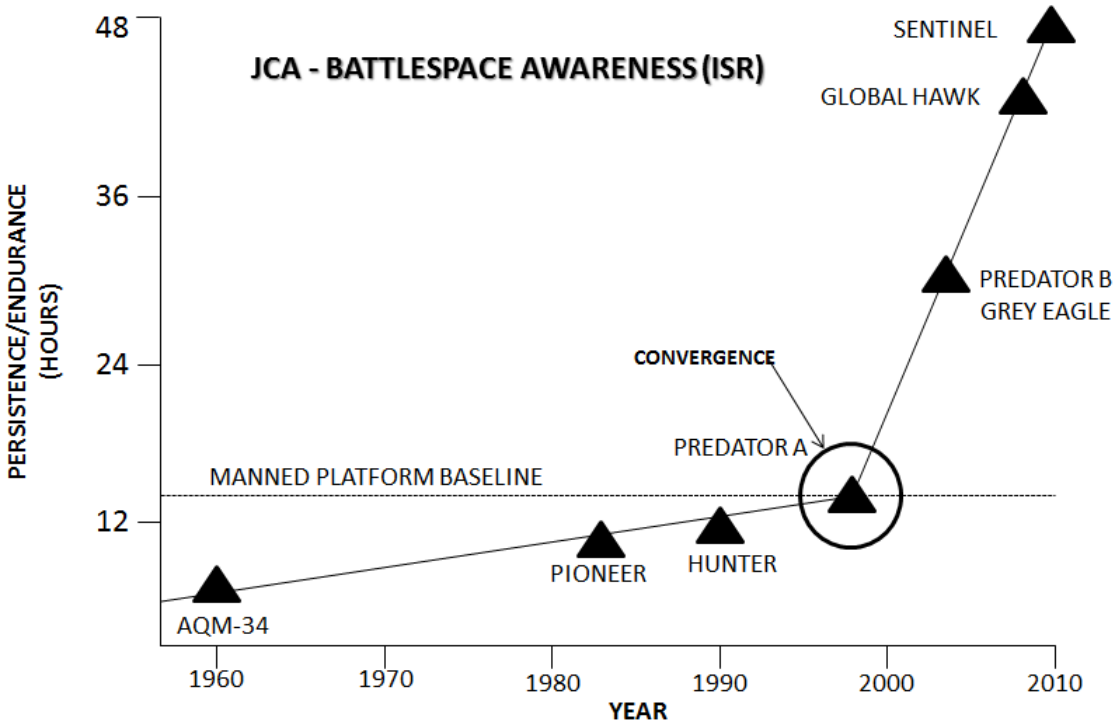

Figure 4. JCA Battlespace Awareness for Unmanned Aircraft[23]

The progress of unmanned aircraft over the past decade is enormously important. It is an example of how the military can invest in sustaining innovations to its force structure while simultaneously capitalizing on disruptive ones as well. Although war motivated this change, innovation – both sustaining and disruptive – are also still relevant in a fiscally conservative environment during peacetime. Adversaries will remain unpredictable, agile and adaptable which requires us to be the same.

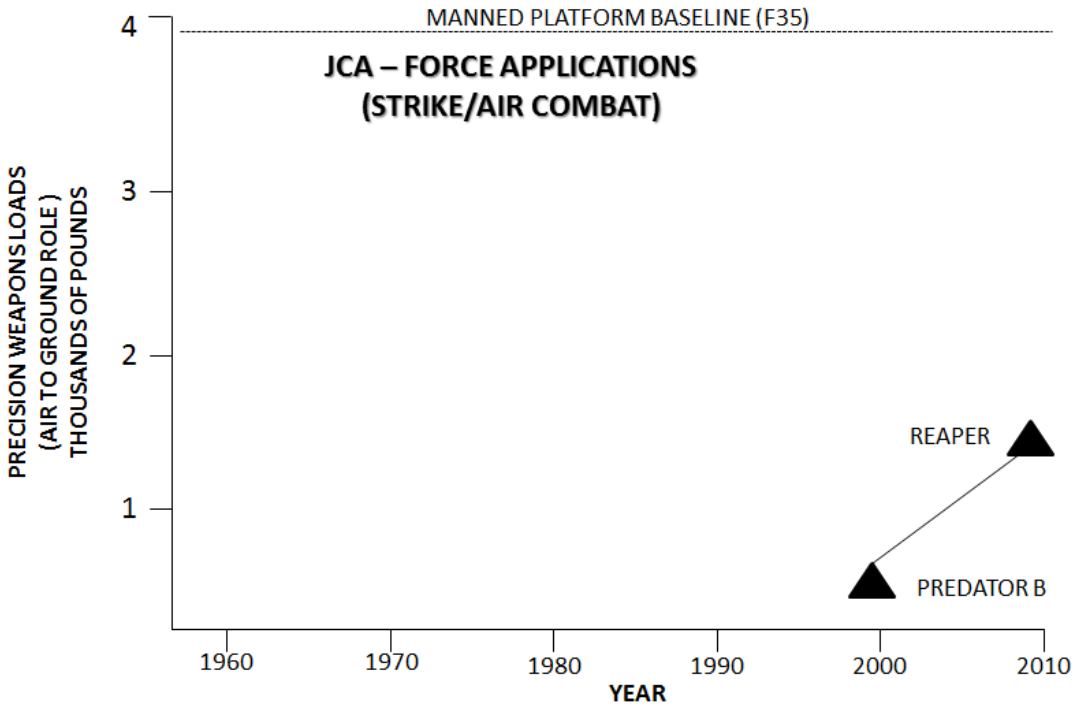

Figure 5. JCA- Force Applications for Unmanned Aircraft[24]

Why Should We Worry and How Do We Manage Disruptive Technology in Peacetime?

In preparing for future wars, the U.S. military must anticipate new threats. In the post-conflict era it will be quite difficult to replicate this experience in other disruptive technologies. The tendency of the acquisition system during economic hard times is to return to the traditional way of doing business. This system rewards product performance and invests in weapon systems that are proven in combat but investment in technologies that don't fit inside doctrine and don't meet consumer demands is likely to be ignored. These same disruptive technologies will most likely be viewed by adversaries differently which is exactly why we should worry.

The military must be adept at recognizing the value of disruptive innovation in peacetime as it has done in war. We must also recognize that our adversary is more likely to adopt this approach for the very reasons we struggle. Our superior strength and

technology is without peer and our adversaries will consequently adopt methods and technologies to counter this. Most likely these will be something completely disruptive. (See chart below) There are many historical lessons that demonstrate this point. During World War I, the German exploitation of the submarine against the British Navy is a clear example.

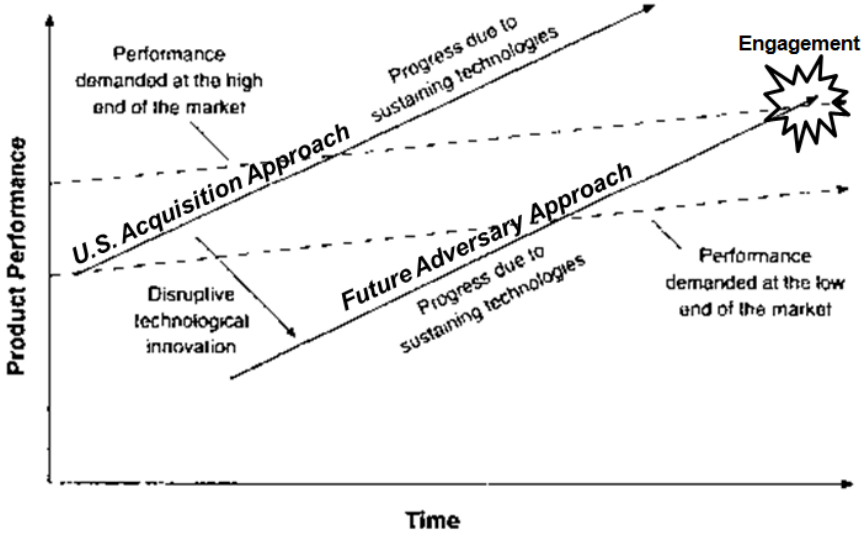

Figure 6. The Impact of Sustaining and Disruptive Technological Changes[25]

On the eve of the First World War, Great Britain was leading the world in naval power without a significant peer. In 1916, Sir John Jellicoe, with a long lineage of naval command experience revered by peers and superiors alike, was the First Sea Lord responsible for this premier naval force. On Christmas Eve 1917, however, he was abruptly removed from office by Prime Minister David Lloyd George due to his inability to prevent the loss of merchant ships destroyed by German U-Boats. Often criticized for their inability to adapt to these German's tactics, the Royal Navy understood submarine lethality and invested in submarines as well as anti-submarine weapons (ASW) but they were ill-prepared to deal with the nature of employment.[26]

The primary task of the Royal Navy during this era was “battle at sea” and destruction of the German naval fleet, “all other operations are subsidiary to this end.”[27] The strength of the British Navy was focused on the superiority and number of dreadnoughts available to offensively attack the enemy. Everything in British naval theory was geared for a clash at sea between two opposing forces. The British Navy, however, was not prepared to deal with the German’s use of U-Boats against the merchant fleet. The metric of protecting merchant vessels was not central to British naval strategy. Their efforts were focused on fighting the German Navy head to head. While U-boats were limited in their ability to subvert the British advantage in the core metric of naval warfare, they were more than able to defeat the British ability to protect their merchant fleet.[28]

The submarine posed both sustaining and disruptive innovations. The sustaining innovation was the British Navy’s ability to defeat the submarine in an offensive fight utilizing ASW and tactics but when the German’s used U-Boats to attack merchant ships instead, the metric changed and this became a disruptive innovation. The British Navy’s inability to adapt known offensive sustaining innovations against the German Navy’s disruptive approach exhibits the blind spot alluded to earlier. This example echoes similar innovative approaches used today by our adversaries to disrupt U.S. efforts to secure national interests. This should be a warning of why we should worry. Failure to adapt to disruptive innovations as well as adopt disruptive innovations could lead to an adversary’s advantage and potential catastrophe.

The theory of disruptive innovation offers a valuable framework for understanding how and where threats are likely to emerge, an attribute quite indispensable to the

military. Trailing organizations (or nations)—those not captive to the dominant paradigm—are more likely to find applications where disruptive technologies meet different requirements. If the U.S. is not careful and methodical in its future approach, the military will fail to properly manage disruptive technologies and could risk failure in its core mission.

The U.S. management of unmanned aircraft over the past decade would seem to offer hope that the military can adapt. Contact with the enemy in Afghanistan, Iraq and elsewhere increased the importance of missions for which UAS were particularly well-suited—missions with significant persistence and battlespace awareness requirements. This drove major new investments in unmanned platforms. As a result, UAS are now on a trajectory of long-term, sustaining innovation in which they are likely to supplant manned aircraft in numerous other areas.

In preparing for future wars, the U.S. military must continue to anticipate new threats. Because the U.S. is the global leader on land, sea, air, and beyond, adversaries are likely to threaten the U.S. in ways that seek to circumvent these advantages. Only foolish adversaries would challenge them directly. The military should, therefore, refocus its attention from the incremental improvements to existing technologies to something that facilitates the disruptive ones as well. Although the existing acquisition system is geared to the successful management of sustaining innovations it is capable of overcoming these obstacles and the lessons from the UAS experience should encourage not discourage adaptation.

Warfare is enormously expensive and dangerous and it’s imperative that we continue to capitalize on innovation, both disruptive and sustaining, to remain relevant.

History is wrought with examples of failure and success in adopting, or failing to adopt, innovations. Unmanned aircraft is one example of how disruptive technology was used successfully by the U.S. to change the way we fight today. Although being the most sophisticated and technologically superior force in the world is important, it is not enough. Our adversaries will continue to seek the advantage in other areas. The security of our Nation is at stake if we fail to take the lessons learned and apply them in our future conduct.

Endnotes

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[7] Ibid.

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[21] James A. Winnefield and Frank Kendall, *Unmanned Systems Integrated Roadmap 2011-2036*, (Washington, DC: U.S. Department of Defense, November 9, 2011), 16.

[22] Ibid, 22. Data extrapolated from Table 1.1.

[23] Ibid.

[24] Ibid.

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[27] Ibid.

[28] Ibid, 141-142.