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NATIONAL DEFENSE UNIVERSITY
JOINT FORCES STAFF COLLEGE
JOINT ADVANCED WARFIGHTING SCHOOL



AUTONOMOUS POWER: From War to Peace in the I-Robot Millennium

By

Frank B. Schreiber

Lt Col, USAF

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By

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A paper submitted to the Faculty of the Joint Advanced Warfighting School in partial satisfaction of the requirements of a Master of Science Degree in Joint Campaign Planning and Strategy. The contents of this paper reflect my own personal views and are not necessarily endorsed by the Joint Forces Staff College or the Department of Defense.

This paper is entirely my own work except as documented in footnotes.

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Abstract

At its core, this thesis is about ways and means exponentiation. In the national strategic planning calculus, when the strategy for applying ways and means outstrips desired ends, the resulting outcome is risk. Autonomous power, the fruitful combination of artificial intelligence with autonomy, creates a method of producing ways and means at a scale unprecedented in human history, driving down risk. Imagine if a nation could accomplish all of the ends dictated by core national interests and still possess a surplus of ways and means designated for accomplishing the altruistic endeavors that so frequently lose out in a world hamstrung by limited resources. So powerful is this new concept that it bears consideration as a new element of national power, perhaps even more dominant than the diplomatic, information, military and economic elements of the past.

Dedication

This thesis is dedicated to my mother, wife, daughter, humanity, and the eventual abolition of speciesism. Humans invented artificial speciation and successfully created novel species, contributing innumerable benefits to mankind and the world. In the not too distant future, humans will create a new autonomous species based on artificial intelligence that will eventually surpass humans in cognitive superiority. In the post-technological singularity world, it would be comforting to know this superior species learned the most important lessons of the last millennium from us about combating species depredation...and would treat us with love and respect as taught to me by my mother, reinforced by my wife, and exemplified by my daughter.

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AUTONOMOUS POWER: From War to Peace in the I-Robot Millennium

Introduction & Thesis Statement

This thesis explores the emerging phenomenon of autonomous power, which is a combination of autonomy and national power. Autonomy conveys artificial intelligence independent of human control. National power conveys the ability to influence others to secure a desired outcome. Therefore, autonomous power is national power applied independent of human control. The research was designed to answer the following research question: Should autonomous power be elevated to a status equivalent to the other primary instruments of national power? The author stated his belief in the following hypothesis: The U.S. will benefit from immediate development of a single consolidated U.S. strategy for operationalization of autonomous power at the highest intergovernmental level. The call for immediate development acknowledges the current state of affairs as being in relative turmoil. The implementation of comprehensive autonomous power policy continues to be delayed by unproductive debate as to the depth and breadth of application of autonomous systems (lethal and non-lethal) due to legal, psychological, and ethical considerations. This delay results in a substantial retardation in building the foundation for comprehensive employment of autonomous power across the spectrum of peace and conflict. Continued delays in implementation of autonomous power policy places our nation and the world at high risk.

Chapter 1 delves into the concept of national power. It briefly touches upon realism, one of the most popular international relations worldviews within which national power emerges. The chapter then covers the broad phenomenon of national power to

highlight the emergence of specific instruments of national power characterized by several prominent theorists. It concludes by creating opportunity space for the emergence of a new element of national power, namely autonomous power.

Chapter 2 explores the concept of autonomy. It first explores the state of artificial intelligence (AI). The chapter then highlights existing and predicted command and control (C2) mechanisms for systems employing AI across a spectrum from strong control to limited control. Finally, it extends C2 of AI to the far right of the spectrum and explores full autonomy and a future defined by the Singularity.

Chapter 3 reveals autonomous power as an emerging element of national power consisting of the combination of autonomy and national power. It first synthesizes the first two chapters on national power and autonomy and proposes a framework for understanding autonomous power. It then proposes a definition for autonomous power and describes what autonomous power is and is not. Finally, the chapter provides examples of autonomous power across the spectrum of peace and conflict.

Finally, Chapter 4 provides a recommendation for development of a national strategy for autonomous power. Next, it relates autonomous power to the fundamental human enterprise. It then proposes the adoption of a new profession for autonomists, a specialization for guiding national efforts in managing the emerging element of autonomous power. It concludes by proposing a multi-year framework for developing strategy for applying autonomous power.

“I put for a general inclination of all mankind, a perpetual and restless desire of power after power, that ceaseth only in death.” (Thomas Hobbes)

“Nearly all men can stand adversity, but if you want to test a man’s character, give him power.” (Abraham Lincoln)

Chapter 1: National Power

When challenged to contemplate the most powerful phenomenon on planet Earth, it is not uncommon for people to begin by thinking of very specific powerful things. Manmade nuclear fusion in thermonuclear weapons immediately comes to mind, especially since it represents an analog of the naturally occurring nuclear fusion power that drives the Sun and stars. The Large Hadron Collider at the European Organization for Nuclear Research is not only Earth’s largest and most powerful particle accelerator operating at the boundaries of scientific knowledge, it is the largest machine on Earth. The existence of life itself is another powerful phenomenon. It has literally shaped planet Earth by its biodiversity and ability to self-replicate, creating a combined biomass that would otherwise exceed the Earth’s capacity to sustain its exponential growth if it were not for other mitigating factors. Yet all of these specific powerful things pale in comparison to the truly most powerful phenomenon on earth: intelligence. Intelligence and the powerful ideas born of it are responsible for creating the phenomenon described above or for the capability to understand, describe, and perhaps someday control them. “The capacity to collect, share, reorganize and act on information is unlike anything else

in this universe. Intelligent beings can build tools, adapt to and radically change their environment, create complex systems and act with reasoned intention. Intelligent beings can plan, solve problems, think abstractly, comprehend ideas, use language and learn.”¹ One of those powerful ideas born from human intelligence is the concept of national power.

Realism

While not beholden to any one in particular, the concept of national power emerges from the international relations (IR) worldview most commonly associated with Thomas Hobbes and Hans Morgenthau: realism.² Realism represents a tradition of IR theory centered upon four propositions: an anarchic international system; states as the most important actors in that system; an international system of rational, unitary actors; and survival as the primary concern of all states.³ An anarchic international system reflects the lack of authority in a central world government capable of establishing order among independent nations on Earth. The terms rational and unitary characterize each independent actor looking out for their own interests and states themselves functioning as individual actors rather than actions of a collection of individuals within each state. Given the realist worldview, an accumulation and maintenance of national power in a variety of forms relative to other states emerges as a compelling national interest and

¹ George Dvorsky, “Ranking the Most Powerful Forces in the Universe,” 24 Jun 2009. URL: <http://www.sentientdevelopments.com/2009/06/ranking-most-powerful-forces-in.html>, accessed 1 Jan 2015.

² David Jablonski, “National Power”, in The U.S. Army War College Guide to National Security Issues, Volume I: Theory of War and Strategy, 4th Edition, Strategic Studies Institute, U.S. Army War College, 2010, p. 123

³ Jack Donnelly, “The Ethics of Realism”, in Christian Reus-Smit, Duncan Snidal (eds.), *The Oxford Handbook of International Relations*, Oxford University Press, 2008, p. 150

provides the surest means to facilitate survival.⁴ According to early theorists, national power is not only an end (accumulation of national power), but also a means to that end (application of national power). So if national power is so critical to achieving national interests, what is it?

National Power

Early theorists defined national power in a number of ways. Morgenthau defined national power as “anything that establishes and maintains the control of man over man.”⁵ Morgenthau emphasized the aspect of control over man in an international relations context. As might be expected given a realist worldview, control of man reflects the ability to manipulate circumstances in one’s favor to accomplish ends in the national interest. In his treatise on world politics, A.F. Kenneth Organski defined power as “the ability to influence the behavior of others in accordance with one’s own ends.”⁶ Organski emphasized the aspect of influencing behavior towards an end without clarifying an object of the action more specific than “others.” This definition expands the feasibility of control over something other than man and is therefore more favorable as a definition as it relates to this thesis. For the purpose of this work, national power will be broadly and sufficiently defined as the ability to influence others to secure a desired outcome.

The aforementioned early theorists also expanded upon the definition of national power by outlining some specific instruments or determinants. Organski first offered the

⁴ Hans Morgenthau, "A Realist Theory of International Politics," in *Politics Among Nations: The Struggle for Power and Peace*, 5th ed. New York: Alfred A. Knopf, 1978, p. 5

⁵ Morgenthau, p. 9

⁶ A.F.K. Organski, "The Nature of National Power," in *World Politics*, 2nd ed., New York: Alfred A. Knopf, 1968. Pg. 104

existence of individual instruments of power such as “wealth, resources, manpower, [and] arms.”⁷ Working together, Katherine and Kenneth Organski added skill and efficiency of government to manpower and wealth.⁸ More recently, Jablonski more completely distinguished between natural and social determinants of power. “The natural determinants (geography, resources, and population) are concerned with the number of people in a nation and with their physical environment. Social determinants (economic, political, military, psychological, and...informational) concerned the ways in which the people of a nation organize themselves and the manner in which they alter their environment.”⁹ Theorists eventually postulated a macro set of instruments which formed the core of the national power calculus. In modern terms and codified in U.S. joint military doctrine, this core is commonly abstracted as diplomatic, information, military, economic, financial, intelligence, and legal (DIMEFIL) instruments¹⁰ with their associated political, military, economic, social, information, infrastructure (PMESII) systems.¹¹ The primary core instruments continue to be defined as the DIME.

In terms of the means of applying power in the American system of government, the executive branch packs a heavy punch. With over 4 million personnel and more than \$3T in budgetary authority, the executive branch out-punches the legislative (30K/\$7B)

⁷ IBID, Pg. 106

⁸ Katherine Organski and A.F. Kenneth Organski, "Population and Power," in *Population and World Power*, New York: Alfred A. Knopf, 1961. Pg. 27

⁹ David Jablonski, "National Power", in *The U.S. Army War College Guide to National Security Issues, Volume I: Theory of War and Strategy*, 4th Edition, Strategic Studies Institute, U.S. Army War College, 2010, p. 126

¹⁰ U.S. Joint Chiefs of Staff, *Doctrine for the Armed Forces of the United States*, Joint Publication 1. Washington, DC: U.S. Joint Chiefs of Staff, March 25, 2013. Pg. I-1. http://www.dtic.mil/doctrine/new_pubs/jp1.pdf

¹¹ U.S. Joint Chiefs of Staff. *Joint Operations*, Joint Publication 3-0. Washington, DC: U.S. Joint Chiefs of Staff, August 11, 2011, Pg. I-1. http://www.dtic.mil/doctrine/new_pubs/jp3_0.pdf

and judicial (30K/\$5B) branches by several orders of magnitude. Across the core instruments described above, four in the executive branch stand out based on their direct connection to U.S. national security strategy. Over the last several U.S. National Security Strategy documents signed by the President, the most recent published in 2015, the core national interests included security, prosperity, values, and international order. Conveniently, those four national interests synchronize directly with the military, economic, information, and diplomatic instruments of national power, respectively. Those four national interests and associated instruments of national power benefit significantly from servicing by three powerful department-level organizations and one bureau including the Department of Defense, Department of the Treasury, Bureau of International Information Programs, and its parent organization, Department of State, respectively. Not surprisingly, these three executive departments are among the oldest primary units of the executive branch of government.

Even among those four primary core instruments of national power, there exists a hierarchy based on their relative strengths. In that regard, the economic instrument reigns supreme as the behemoth among majors. The U.S. national economy, the largest in the world, represents the means engine driving everything our national government desires to achieve in domestic and international affairs. Commonly referred to as the “power of the purse” and wielded largely by the U.S. Congress, all initiatives pertaining to any instrument of national power exist as a direct consequence of budgetary outlays courtesy of the funding produced by the national economy. Just like a household budget, it must be managed effectively in a resource-constrained reality to provide the most value-added per dollar spent. More than 50% of national budget expenditures go toward mandatory

spending categories such as entitlements (e.g. Social Security, Medicare) and the remainder, less interest on the debt, become available for discretionary spending.

From a discretionary spending standpoint, the military instrument of national power represented by the Department of Defense carries considerable weight. In March 2014, President Obama sent congress a proposed defense budget of nearly \$500 billion, more than all other discretionary spending categories in other departments combined. Table 1 (next page) reflects the various executive departments aligned based on the preponderance of national interests served, listed in order of total outlays in billions of dollars. While some departments serve multiple national interests and their alignment in the table could certainly be subject to debate (e.g. Transportation's alignment in Security or Prosperity), a clear distinction regarding the weighting of interests can be extrapolated.

Diving down to the next level of granularity within the military instrument of national power, J. David Singer contributed to defining certain instrumental sub-elements in his Correlates of War (COW) project. This ongoing project attempts to develop reliable variables within the military instrument of national power. Some of those variables included the size of a country's military, energy consumption, population size, urbanized population, raw material production, alliances, territorial relationships, and membership in intergovernmental organizations.¹² After over four decades in operation, the COW project continues actively seeking further correlations to explain the nature of the military instrument of national power. It represents other similar projects carried out on behalf of researchers interested across the range of instruments.

¹² David J. Singer and Melvin Small, *The Wages of War, 1816-1965: A Statistical Handbook*, New York: Wiley, 1972. URL: <http://www.correlatesofwar.org/>, accessed 1 Jan 2015.

Table 1: Executive Departments Aligned with Primary National Interests (Outlays in \$BN)

Security (735)	Prosperity (550)	Values	Int'l Order
Defense (500)	Labor (130)	Justice (50)	State (15)
Veterans Affairs (100)	Agriculture (130)		
Transportation (70)	Interior (90)		
Homeland Security (40)	Health & Human Services (80) - <i>Note 1</i>		
Energy (25)	Education (45)		
	Housing & Urban Development (40)		
	Treasury (20)		
	Commerce (15)		

Note 1: Excluding \$930B in Non-Discretionary Outlays (e.g. Social Security, Medicare)

New Instruments & Perspectives

While the primary core instruments of national power and the specialized sub-elements offered by theorists and practitioners over the years represent a comprehensive treatment of the topic, the model is by no means exhaustive and exclusive. Throughout its history, COW added new variables and more continue to be proposed. Thus, there is room in the national power dialog for new primary core instruments and sub-elements to be discussed if they merit consideration. Cyberspace represents an example of a relatively new sub-element of the information instrument of national power. Prior to the 20th Century, this instrument mainly concerned itself with strategic communications and propaganda. After the invention of the first digital computer in the mid-1930s, the interconnectivity of computers via the Internet in the late 1960s, and the realization cyberspace ubiquity in everyday life around the globe in the 21st Century, purveyors of the information instrument added cyber as an increasingly powerful sub-element. In the U.S., the day-to-day application of power in this sub-element now relies upon

cooperative participation by multiple departments of the federal government to include Defense and Homeland Security, with an increasing trend towards centralizing control.

From a different perspective, new instruments suggested for inclusion in the national power calculus need not remain beholden to realist roots. While realism originally described national power, new instruments have the potential to tie into liberalist and constructivist models for understanding our world, or even redefining the nature of power in new contexts. All of the aforementioned instruments and sub-elements can be re-interpreted through liberalist and constructivist lenses. From a liberalist perspective, states will give up power to international organizations for peace, security, and other intangible benefits. New elements of national power which convey benefits internationally, have the potential to attract adoption by adherents of the liberalist model. From a constructivist perspective, ideas and identities offer the promise of effecting real and permanent positive change since the world is socially constructed and can therefore be enhanced through deliberate intervention. New elements of national power which convey the value of a higher idealistic purpose or provide sufficiently compelling and positive identities have the potential to attract adoption by adherents of the constructivist model.

Finally, new instruments suggested for inclusion in the national power calculus should possess synergistic effects when combined with other instruments of national power. As an example, the aforementioned wide-ranging influence of the economic instrument demonstrated clear multiplying effects on the others. New elements with this quality have a higher potential for adoption since they are mutually supporting, reinforcing, and work best when used in combination.

In summary, the characteristics that make a new instrument ripe for inclusion in the national power discussion include a direct tie to national interests, a government department capable of providing the means to conduct the work needed by that instrument, and the capability to inform and enhance existing worldviews and instruments.

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“We can only see a short distance ahead, but we can see plenty there that needs to be done.” (Alan Turing)

“A year spent on Artificial Intelligence is enough to make one believe in god.” (Alan Perlis)

Chapter 2: Autonomy

Artificial Intelligence

Today in the first world, it’s hard to get through a typical day without experiencing some form of interaction with artificial intelligence (AI). For most people, the act of calling customer service at just about any major business results in a hopefully brief and productive interaction with an AI-controlled operator. Those billions of Google searches conducted by millions of people around the world employed at least two versions of AI. The first called Google Instant attempted to predict what you were searching for and offered suggestions based on the most popular and likely candidates.¹ The second called Googlebot employed AI crawler technology to “automatically discover and scan websites” to provide more accurate and relevant search results.² Both conducted millions of simultaneous operations with ease without human intervention. If you purchased a car recently, it’s likely you were offered an expensive option for the vehicle to assume some form of control over the experience in the form of lane keeping,

¹ Olga Kharif, “Google Uses AI to Make Search Smarter,” Bloomberg Businessweek – Technology, 21 Sep 2010, URL: <http://www.businessweek.com/stories/2010-09-21/google-uses-ai-to-make-search-smarterbusinessweek-business-news-stock-market-and-financial-advice>, accessed 1 Jan 2015.

² Google Support, “Google Crawlers,” URL: <https://support.google.com/webmasters/answer/1061943?hl=en>, accessed 1 Jan 2015.

emergency braking, or automatic parking.³ Autonomy manifests itself in a variety of forms including vehicles, robots, software, and networks. But on this nearly 60th anniversary of the founding of AI research, it's not uncommon for one to ask what became of the lofty promises made six decades ago. In nearly all of the cases described above, it is likely you didn't get exactly what you wanted 100% of the time and perhaps even became frustrated by the result.

In 1950, Alan Turing published the article "Computing Machinery and Intelligence" where he speculated about the possibility of creating machines that could think.⁴ In it he proposed his famous "Turing Test" where an isolated human interrogator is challenged with attempting to determine the difference between human and computer subjects based on solely their responses to questions. With the advent of the first stored program computer in the mid-1950s, it was nearly time to put Turing's Test to the test.

The birth of AI is said to have roots at the Dartmouth Summer Research Project on Artificial Intelligence.⁵ Held at Dartmouth College, Hanover, New Hampshire, in the summer of 1956, attendees boldly predicted the invention of a machine as intelligent as a human and capable of passing the Turing test within a generation. However, as of 2015, the most advanced AI to have successfully completed the Turing Test were only capable of convincing 30-60% of the judges they were human. AI chatterbots such as Eugene Goostman, Cleverbot, and Jaberwacky were but a few examples of AI achieving middling success in this limited display of intelligence credentials. While these results

³ Oleg Gusikhin, Nestor Rychtyckyj, and Dimitar Filev. "Intelligent Systems in the Automotive Industry: Applications and Trends," *Knowledge and Information Systems* 12, no. 2 (2007): Pg. 147-68.

⁴ A.M. Turing, "Computing Machinery and Intelligence," *Mind*, no. 59 (1950): Pg. 433-460. URL: <http://loebner.net/Prize/TuringArticle.html>, accessed 1 Jan 2015.

⁵ Pamela McCorduck, *Machines Who Think: A Personal Inquiry into the History and Prospects of Artificial Intelligence*, San Francisco: W.H. Freeman, 1979.

did not live up to the predictions of the Dartmouth Conference attendees, they were still quite impressive. The fact at least 30% of judges were convinced a computer simulated human intelligence is notable. However, simulating intelligence is not the same as possessing intelligence.

The propagation of limited domain intelligence AI capable of passing Turing tests, beating humans at chess and Jeopardy, and performing other limited tasks is a critical first step toward creating AI capable of more generalized intelligence. Futurists generally agree AI in the form of a Singularity, where AI will exceed human intellectual capacity and control, will likely occur sometime during the 21st Century. “A 2012 Singularity Summit study of artificial general intelligence (AGI) predictions by experts found a wide range of predicted dates, with a median value of 2040.”⁶ At roughly 25 years from now, this mean predicted date is easily within the lifetimes of the typical reader of this text. What then happens between now, when AI is clearly within human capacity and control, and the Singularity AGI, when it is not? This question serves as a good transition to the subject of control.

Autonomous AI Control

Regarding the subject of control, the spectrum is typically bracketed by full human control on one end and fully autonomous operation on the other. The Department of Defense Unmanned Systems Integrated Roadmap FY 2011-2036 specifically identified four levels of autonomy:

“Level I, human operated, indicates a human operator making all decisions. The system has no autonomous control of its environment although it may have information-only responses to sensed data. Level II, human delegated, indicates that the vehicle can

⁶ Stuart Armstrong, “How We’re Predicting AI,” The Singularity Summit 2012, URL: http://library.fora.tv/program_landing.php?year=2012&month=10&day=14&title=Stuart_Armstrong_How_Were_Predicting_AI&pagenumber=&pe=, accessed 1 Jan 2015

perform many functions independently of human control when delegated to do so, encompassing automatic controls, engine controls, and other low-level automation that must be activated or deactivated by human input and must act in mutual exclusion of human operation. Level III, human supervised, indicates the system can perform a wide variety of activities when given top-level permissions or direction by a human. At this level, the human and the system can initiate behaviors based on sensed data, but the system can do so only if within the scope of its currently directed tasks. Level IV, fully autonomous, indicates the system receives goals from humans and translates them into tasks to be performed without human interaction. At this level, a human could still enter the loop in an emergency or change the goals, although in practice there may be significant time delays before human intervention occurs.”⁷

Table 2 provides a graphical depiction of these levels.

Table 2: DoD Unmanned Systems Integrated Roadmap FY 2011-2036 Levels of Autonomy

Level	Description
I – Human Operated	Human operator makes all decisions.
II – Human Delegated	System performs delegated functions independently.
III – Human Supervised	System performs many activities with permission.
IV – Fully Autonomous	System performs all activities independently.

In a previous thesis, this author wrote extensively regarding the potential benefits of greater levels of control autonomy on the decision-making model. In summary, assuming a fully effective autonomous system capable of accomplishing all of its intended goals, decision-making models are significantly accelerated as you approach Singularity AGI compared to human-based equivalents.⁸ Even at today’s modest levels,

⁷ Department of Defense, Office of the Undersecretary of Defense for Acquisition, Technology, and Logistics. *Unmanned Systems Integrated Roadmap FY2011-2036*. (Washington, DC: DSB, 2013) URL: <http://www.defense.gov/pubs/DOD-USRM-2013.pdf>, accessed 1 Oct 2014.

⁸ Frank Schreiber, “The Unmanned Combat Air Vehicle Operational System Command and Control Model-Enhancing the U.S. Air Force Tactical Operations-Intelligence Relationship,” Joint Military Intelligence College, August 2000. At the dawn of this new millennium, this author sought to determine if unmanned control environments were more conducive to combat decision making. Nearly 15 years hence, many of the capabilities postulated at that time have come to fruition at an increasingly accelerated pace, and autonomous power is taking on a greater role in assisting in the achievement of national interests.

this acceleration is primarily based on the superior data processing speed of machine-based AI over human intelligence. Another factor which accelerates decision-making speed includes the massively parallel processing capable with machine-based AI such as in the Google example above. “The combination of AI and greater levels of autonomy create a circumstance where many of the limits of human-based systems can be overcome. The US Department of Defense launched a long-range research and development planning effort, and DoD leaders stated that robotics and autonomous systems will be a critical component. Swarming robotic systems will be key to sustaining US military dominance, as they can create decisive advantages over adversaries by bringing greater mass, coordination, intelligence and speed to the battlefield.”⁹ Military applications of autonomous AI cover all warfighting domains such as air, sea, ground, space, and cyber.

But autonomous AI (AAI) can manifest itself in more than just the military instrument of national power. Since its inception, AI and non-AI autonomous systems augmented, replaced, or changed behavior in humans in a variety of commercial and industrial functions representing the economic instrument of national power. As noted at the beginning of this chapter, we are already familiar with AAI and its impact on customer service and cognitive assist functions in the front-end of business and commerce endeavors. However, it is also widely employed in the back-end, such as in the first phase of the credit check and approval process to augment human cognition. Banks with millions of potential customers can conduct initial screening autonomously

⁹ Paul Scharre, “Swarming the Battlefield,” Web blog post, *Defense News*, Defensenews.com, January 2015. URL: <http://www.defensenews.com/story/defense/commentary/2015/01/05/commentary-swarming-battlefield/21290287/>, accessed 1 Oct 2014.

and filter only serious candidates to be serviced by human loan officers. Industrial-scale AAI processing of this type conveys serious advantages in applications across all of the instruments, especially in the sub-elements (e.g. Military - strategic communications, and intelligence).

Beyond front and back-end business and commerce examples, the growing industrial robotic industry is an example of successful integration of AAI in the global economy in the production sector to augment or replace humans. Every day, millions of products emerge from processing plants reliant upon AAI robotics to conduct dirty, dangerous, and repetitive jobs including cutting, welding, and assembly. Economies of scale dictate use of these technologies since they far surpass human skill and patience, increase quality of the end-product, and cut the overall cost of production.

Similarly, AAI capabilities abound in and are uniquely suited for the supervisory control and data acquisition (SCADA) environment. SCADA systems maintain constant alert via an interconnected web of national infrastructure nodes monitoring potable water treatment and distribution, wastewater treatment and collection, oil and gas distribution, power transmission and distribution (including nuclear), civil defense sirens, and large communication networks. The benefits of AAI in this regard reflect another unique capability of these systems over their human counterparts. Immanuel Kant described human reliance upon “phenomenon” to interact with the real and virtual worlds, whereas AI in the virtual world possess sensory access to the “noumenon, or the thing in itself.”¹⁰ In short, humans must rely upon computer monitors, graphical user

¹⁰ Immanuel Kant, *Immanuel Kant's Critique of Pure Reason*, Unabridged ed. New York: St. Martin's Press, 1965.

interfaces (GUI), and an optical nerve to interface with and understand what's represented in the virtual SCADA environment. Conversely, AI bypass the GUI, directly interfacing with the environment itself in cyberspace. This eliminates the need for retarding translating layers which strip away critical meta-data properties (e.g. underlying digitized measurements) suitable for enhanced processing and analytics at insanely detailed orders of magnitude and speed.

To illustrate this point, in a joint WNYC and National Public Radio Podcast series called Radio Lab, hosts Jad Abumrad and Robert Krulwich conducted a segment entitled "Speed." In it, author and technologist Andrew Zollie shattered public conception of how U.S. financial markets actually work. According to Zollie, "between 50 and 70 percent of all trades in the New York Stock Exchange (NYSE) are not executed by a human being as a result of a human decision. They are actually executed by an algorithm at a speed, rate, and scale that is beyond comprehension."¹¹ To find out just how fast, Jad consulted with Mr. Mike Beller, the Chief Technology Officer at the financial technology company Tradeworx, a high-frequency proprietary trading business. On a randomly selected day, they explored Yahoo stock trade activity at 11:35am and 26.979 seconds. According to Beller, this equated to 41,729,979,559 microseconds since midnight (the preferred unit of measurement), an exceedingly unreal and inhuman specificity.

"A high-frequency trader might do a thousand trades in a minute, but it is very 'bursty' (microsecond bursts). It is very hard to see what is going on. [While testing the market, these algorithms] create huge volumes of transactions that just disappear into the ether. There are some computer algorithms whose sole job is to combat other algorithms."¹²

¹¹ Jad Abumrad, Speed, Radio Lab [Radio Series Episode], Season 11, Episode 4. New York, 2013.

¹² Ibid.

Trades which twenty years ago used to take non-computer-assisted humans more than 10 seconds to complete, now take less than one-tenth of a second, a rate that continues to fall precipitously. This level of enhanced processing and analytics is only possible with AAI and can only be combatted with equally agile AAI countermeasures.

As noted, even non-AI autonomous systems possess the ability to change behavior in humans. As one might imagine, police presence to ensure public safety and enforce law largely remains limited due to the difficulty of recruiting, training, and retaining sufficient officers to satiate demand. In a form of means multiplication, non-AI monitoring systems serve to enhance human behavior in public places. The venerable red-light camera is a prime example of behavior change on an industrial scale, impacting millions of commuters around the world in a positive way. The dual-use technology represented by autonomous camera systems serves valid public safety and behavioral change purposes in one mode, but remains poised to support other endeavors such as homeland defense if needed. The effectiveness of ubiquitous non-AI monitoring systems, such as those used in France to facilitate the eventual apprehension of the Charlie Hebdo terrorists, will someday rely more on AAI to speed the process.

The rapid advancement of autonomous AI capabilities have the potential to provide meaningful positive impacts across all of the instruments of national power. The next chapter explores some of those possibilities and the driving rationale for considering this unique combination for status as an instrument in its own right.

“Artificial Intelligence is our greatest existential threat.” (Elon Musk, 2014)

“I chose to believe that I was a person, that I had the potential to become more than a collection of circuits and sub-processors.” (Data, circa 2369)

Chapter 3: Autonomous Power

Autonomous Power Synthesis

Technologically, the initial signs harkening the arrival of the age of AAI began at the start of the 21st Century. Fifteen years later, the U.S. government remains far behind our nearest peer competitor, China, struggling unnecessarily with legal, psychological, and ethical considerations. As Armin Krishnan puts it, “the RMA triggered by IT, robotics, AI and nanotechnology in some aspects resembles the situation immediately after the Second World War. When the nuclear bomb was invented political decision-makers did not fully understand its strategic implications.”¹ To be certain, China and other adversaries of the U.S. with the capability and intent to counter traditional U.S. instruments of national power understand the strategic implications and will certainly take advantage of our weakness in resolve.

For those not yet convinced of China’s dominance in the AAI market, simply conduct a search for the top companies manufacturing this technology for the commercial

¹ Armin Krishnan, *Killer Robots Legality and Ethicality of Autonomous Weapons*, Farnham, UK: Ashgate, 2009. 166.

market today. The search for top commercial quad-copter/drone manufacturers results in a list of companies dominated by China.²

Table 3: Quad-Copter/Drone Manufacturers

Manufacturer	Headquarters	Manufacturer	Headquarters
DJI Innovations	Shenzhen, China	AAI Corp. (Textron)	Maryland, U.S.A.
Walkera	Guangzhou City, China	Aerosight Innovations	Oregon, U.S.A.
Hubsan (Traxxas)	Guangdong, China	Aeryon Labs Inc.	Ontario, Canada
Syma Toys	Guangdong, China	Ares, RC	Illinois, U.S.A.
Blade (Horizon Hobby)	Illinois, U.S.A.	Armattan	Taiwan, China
UDI (Shantou)	Guangdong, China	Aurora Flight Sciences	Virginia, U.S.A.
Cheerson (JH Toys Ind)	Guangdong, China	CAT UAV	Barcelona, Spain
Idea-Fly	Shenzhen, China	Draganfly Innovations	Saskatoon, Canada
SpeedWolf	Shenzhen, China	Droidworx	Waikato, New Zealand
Flying3D	Guangzhou, China	Estes Rockets	Colorado, U.S.A.
Skyartec	Shenzhen, China	Foxtech	Shanghai, China
Meijiixin Toys	Guangdong, China	General Atomics	California, U.S.A.
Parrot	Paris, France	Hobbylord Multi-Rotors	Shenzhen, China
3DR	California, U.S.A.	Northrup Grumman	Virginia, U.S.A.

The world's largest and most prolific AAI drone manufacturer today is DJI Innovations headquartered in Shenzhen, China. The DJI Phantom II Vision +, their most popular drone, weighs about 2 pounds, costs approximately \$1,000, and gave rise to the first Chinese brand to create a whole new consumer category. The best of these drones possess the ability to fly at DoD Autonomy Levels I-III, and reflect those available for public sale. While drones like these have thousands of legitimate uses in sports, entertainment, and other commercial industries, they've also been implicated in widespread incidents of troubling indiscretions. Popular YouTube videos abound with DJI drones capturing footage of private facilities such as the White House and Apple Computer's no-longer-secret headquarters under construction in Cupertino, California.

² Dronebly, "Quadcopter and Drone Manufacturers: The Ultimate List," URL: <http://dronebly.com/quadcopter-and-drone-manufacturers-the-ultimate-list>, accessed 1 Jan 2015 (See also: <http://quadcopterhq.com/quadcopter-manufacturers/>)

Autonomous drones capable of flight independent of human control work properly most of the time. However, increasing incidents of “fly-aways” give rise to at best speculation about who’s really in control and at worst if Chinese Level IV drones exist. To augment millions of dollars spent launching satellites into space to capture relatively poor quality overhead images, China may now be simply charging Americans for the technology to do it for them using higher definition cameras at lower altitudes and posting the results to globally accessible and AI searchable video distribution sites. This type of behavior is consistent with China’s strategy to replace the U.S. as the sole global superpower.³ Like all companies in this industry, DJI employs a very sophisticated social media, marketing and distribution campaign including ultra-professional web presence and ubiquitous availability of their products in many of the most popular retail establishments (e.g. Amazon, B&H Photo, New Egg, Tiger Direct, etc.). Marketing campaigns with slogans such as “The Future of Possible,” “Fly with Your Dreams,” and “Prepare to be Transformative” inspired the purchase of an estimated 10,000 Phantoms per week.

Quadcopters and drones represent just one segment in which Chinese manufacturers dominate the autonomous power market. Another is industrial autonomous robotics. Robotics Business Review cites approximately 120 non-Chinese companies among their RBR 50 which lists “the most influential public & private companies in the global robotics industry.”⁴ In October of 2014, the Chinese Xinhua news agency reported that country has in excess of 400 robotics companies with a goal of

³ Michael Pillsbury, *The Hundred-Year Marathon: China's Secret Strategy to Replace America as the Global Superpower*. Henry Holt and Co., 2015.

⁴ Robotics Business Review, “What is the RBR 50?,” URL: <http://www.roboticsbusinessreview.com/rbr50>, accessed 1 Jan 2015.

expanding to approximately 30 robotics industrial parks in the near future.⁵ This effort is guided by the China Robot Industry Alliance (CRIA) whose charter is to “vigorously promote the development of advanced manufacturing technology and equipments[sic], with the typical representative of robots, is an important mean to the realization of transformation and upgrading of manufacturing and service industries in China.”⁶ Responsible for manufacturing the majority of products the world craves with cheap human labor, even China realizes the benefits of AAI modes over human-based manufacturing.

With China fully committed to AAI capabilities, it is time for U.S. to regain and maintain dominance. As described in Chapter 2, AAI has the capacity to be a force multiplier in any domain. Nations able to successfully capitalize on its benefits will reap the reward of conducting more critical functions without requiring a commensurate increase in personnel. This technologically enhanced modality frees up humans to work on the things in which they excel and places the burden for the rest on AAI. In a resource constrained environment, AAI provides not only a form of ways and means multiplication, but exponentiation, accomplishing more than would otherwise be possible without it. This exponentiation emerges in at least two forms. The first form comprises the raw number of hardware AAI (e.g. drone swarms, micro-bots) that could be produced to attack a problem. In the real world, that number is only limited by the cost of systems U.S. senior decision-makers decide to commission at a significantly reduced cost

⁵ Pete Sweeney, *Reuters*, “In China, High Demand for Robots, but too many Robot Manufacturers,” 28 Oct 2014, URL: <http://www.reuters.com/article/2014/10/28/us-china-robots-idUSKBN0IH28O20141028>, accessed 1 Jan 2015.

⁶ China Robot Industry Alliance, “Message From the Executive President,” <http://cria.mei.net.cn/English/home.asp>, accessed 1 Jan 2015. Original misspelling reproduced here.

compared to human-based systems. In the virtual world (e.g. Googlebot and other software-based AAI), that number reaches toward infinity since there is no limit to the number of simultaneous instances of autonomous AI that could be produced. The second form comprises the product of multiple AAI each creatively working out independent ways to solve a particular problem combined with hybrid approaches discovered through AAI cross-pollination. Right now, the global AAI industry is in an exponential growth period with new innovations coming faster than the last and the U.S. must take the responsibility to lead that segment.

Autonomous Power Definition

Thus far, this thesis defined national power as the ability to influence others to secure a desired outcome, and autonomy as AI independent of human control. To synthesize, this thesis now defines autonomous power as the ability to influence others to secure a desired outcome using AI independent of human control. The application of autonomous power (AP) applies across domains represented by all of the other instruments of national power. Given sufficient impetus to maximize its potential, national decision makers would certainly desire to take advantage of the positive contributions of AP technologies while avoiding any negatives.

This author would go as far as saying AP represents not just a revolution in military affairs (RMA), but a full-scale revolution in the affairs of man. It is fair to say every human on Earth presently embodies what can be considered autonomous natural intelligence. We trust that with the proper environment, education, and motivations, individual humans will make decisions and take actions that will contribute to achieving ends commensurate with national interests. We exert no more control over individual

citizens than simply providing a framework of social norms, including ethical and legal constraints, and the associated consequences for failing to abide by them. Properly constructed and imbued with the same values, legal authorities, and social norms of a just human society, AP systems will eventually be capable of contributing equally with their natural counterparts. The difference is that AP systems will also be able to rapidly adjust to changes in intent regarding ends, ways, and means without the lengthy assimilation modalities and variables of human comprehension and implementation. Simply put, AP systems will immediately act confidently, and in accordance with legal, ethical, and social norms all of the time, every time. The popular science fiction series *Star Trek* presented a utopian view of this type of AP in the form of the character named Data.⁷

What nation would not desire multiple instantiations of this kind of asset contributing to achieving national interests? How comforting would it be to have confidence that every human being would act in a similarly consistent and appropriate way 100% of the time?

Fortunately for only the most powerful nation-states, AP is itself an asymmetric capability reserved for those entities technologically advanced enough to capitalize on its features. While smaller states and non-state actors could certainly purchase modest quantities of AP capabilities, they are incapable of doing so on the industrial scale of a powerful nation. So in the mega-state race to get there first with the most, policymakers should keep a variety of considerations in mind.

As AP technology matures in the near-term and as we approach the Singularity in the long-term, there will be a palpable and understandable fear of it. If facilitated by

⁷ Gene Roddenberry, *Star Trek The Next Generation [TV Series]*, Paramount Domestic Television, first aired 28 Sep 1987, URLs: <http://en.memory-alpha.org/wiki/Data>, and http://www.startrek.com/database_article/data, Accessed 18 Oct 2014.

future research and development (R&D), AP may eventually be capable of self-awareness and more importantly, self-replication, potentially applying orders of magnitude self-improvements based on consciousness of the flaws of its own design and capable of rampant self-optimization. In some scenarios, this could potentially place humanity at risk if R&D of AP is not conducted with extreme care. This is especially true if future generations of AP entities are not imbued with protocols to counter the idea that humans might be considered counterproductive, or worse obsolete. Since the U.S. cannot reliably and consistently control what other entities do with their AP capabilities, they should be considered in the same category as weapons of mass destruction given the potential catastrophic threat to human existence.

In a less dire scenario, there may eventually come a time when professional human warfighters are judged too valuable to sacrifice in warfare, but not AP warfighters. AP warfighters would undoubtedly eventually surpass the skill and effectiveness of even the best human warfighters, to the point of being able to execute successful operations and conduct war and warfare with entirely non-lethal methods. This would be the ultimate expression of an RMA. At its ultimate end, AP may be capable of rendering the entire human race incapable of harming itself. At that time, it will have enabled the transition from war to peace in the I-Robot millennium.

To be clear, this thesis on AP is not a recommendation for the replacement of humans on the battlefield. In fact, most AP systems work best when combined with unique human qualities not yet reproducible in AAI. The AP applications related to the military instrument of power represent only a fraction of those conceivable. The majority of AP capabilities will function during peacetime across all of the other instruments of

national power. The following considers other examples of autonomous power capabilities in action.

Autonomous Power Examples

As previously described, the economic instrument of national power carries considerable weight compared to other national powers. Recall the increasingly deepening complexities associated with the New York Stock Exchange (NYSE) and the present application of AAI capabilities to ensure financial success. As one might imagine, the NYSE represents a critical node in the U.S. economy. Threats to the NYSE manifest through hacking, illegal trading, and even panic represent a direct assault on the engine that drives the progress and prosperity of the American people. But AP presents several answers to the NYSE protection scenario. Currently, to counter major anomalies in the processing of microsecond bursts of NYSE transactions, the system is designed to autonomously shut-down trading in the event of a potential crisis. Like red-light cameras, this relatively unintelligent auto shut-down feature serves as a potential deterrent to modify the behavior of nefarious actors who would want to undermine the economy through an attack on the exchange. But those same actors may simply desire to conduct a denial of service (DOS) attack and the present configuration would facilitate that end. Future AP enhancements to the NYSE would enable monitoring at microsecond or faster increments, launch counter-attacks on isolated rogue algorithm targets and foil a DOS attempt while preserving the remainder of the exchange functions.

Bridging the economic and diplomatic instruments of national power, AP has the potential to revolutionize distribution networks globally. The global retailer Amazon.com recently unveiled its intent to develop Amazon Prime Air, a desired means

of effecting distribution employing AAI drones to deliver product direct to consumers.⁸ Rather than relying upon human drivers slogging through an antiquated hub and spoke distribution system over limited road networks, AAI algorithms will optimize airborne delivery across a matrixed web, employ multiple AAI drones over simultaneous channels of distribution, and deliver packages direct to the consumer in less than 30 minutes. The company currently advertises 56 employment opportunities in the U.S., UK, and Israel for multiple positions to help conceive, develop, seek regulatory approval, and implement this technology strategy. On the diplomatic front, this same technology could revolutionize humanitarian relief operations (HUMRO) conducted by the U.S. Agency for International Development (USAID). USAID HUMROs employing AAI algorithms and drones could bypass antiquated hub distribution centers, which are subject to corruption, and effectuate deliveries direct to the needy. Identification of need could also be determined by AAI image scanning, with results passed to delivery drones real-time.

Another example exists in the domain of the diplomatic instrument of national power. Currently, the U.S. Department of State operates embassies and consulates throughout the world. One of their responsibilities is the processing of visas, the authority for a non-citizen to visit the U.S. for a limited duration. As one of the most popular destinations in the world, the U.S. maintains a national interest in maintaining this country accessible to foreigners as a method of communicating U.S. values while taking advantage of the global diversity represented by those legitimate visitors desiring to come to the U.S. to study or conduct business. U.S. embassies and consulates receive millions of applications for the 675,000 available visas for legal migration to the U.S. per

⁸ Amazon Prime Air, URL: <http://www.amazon.com/b?node=8037720011>, accessed 22 Feb 2015.

year.⁹ Increasingly, visa processing is conducted in advance of visits. As with the previously described credit check system, AP provides the capability to conduct AAI processing of large portions of visa processing. While humans will likely be involved in the terminal phases of the process, autonomous systems can conduct the majority of pre-screening. This greater scrutiny by autonomous systems will help exponentiate human processor capabilities and help deter nefarious actors from surreptitious entry to the U.S.

Yet another example exists in the domain of the information instrument of national power. The Bureau of International Information Programs (IIP) “supports people-to-people conversations with foreign publics on U.S. policy priorities. To carry out this mission, IIP leverages digital communications technology to reach across platforms - from traditional forms of communications to new media channels.”¹⁰ However, personal presence in every forum across multiple platforms and channels is physically impossible with the bureau’s limited staff. Similar to the previously discussed capability of Googlebot to scour the web, AP AAI will provide the ability to achieve constant surveillance of exponentially more forums, platforms, and channels in real-time and provide automated responses to posts that support positive themes, counter adversary messages, and if necessary, notify IIP personnel of emerging trends and threats.

In a final example in the information instrument of national power, AP capabilities could be applied to the desperate national need for highly qualified teachers in primary, secondary, and advanced education. Development of an education-focused AAI virtually replicated on an industrial scale and delivered to the individual desktop

⁹ Immigration Road, “U.S. Immigration Numerical Limitations and Caps,” 29 Oct 2011, URL: <http://immigrationroad.com/visa-bulletin/immigrant-visa-annual-limit-and-cap.php>, accessed 1 Jan 2015.

¹⁰ U.S. Department of State, “Bureau of International Information Programs,” URL: <http://www.state.gov/r/iip/>, accessed 1 Jan 2015.

would revolutionize education. Rather than centrally delivering lowest-common denominator education via the one-on-many mode common in contemporary educational settings (one teacher, multiple students), AAI could deliver many-on-many personalized education to each individual at their own pace and capability (one/many teacher(s) for every student). AAI of this type would be available any time of day to overcome personal scheduling challenges and could be accessed from home, educational centers, or personal mobile devices.

Despite all of these potential capabilities, AP is not a panacea. While it has multiple incredible upsides, there exist many vulnerabilities. Despite limitless potential, AP is fundamentally reliant upon electricity and digital processing and is thus vulnerable to external and internal threats. Until the invention of ironclad electronic hardening technologies, AP will remain at risk from electro-magnetic pulse (EMP) weapons. These weapons render devastating area effects to any electronic devices within range of the EMP. Similarly, any AP capabilities consisting of electronics with wired or wireless external interfaces will be vulnerable to internal threats such as cyber-attack. Mitigation measures to counter these threats to AP should be part of any implementation strategy.

Finally, it is not uncommon for humans to contemplate their status as the only advanced intelligent lifeform in the observable universe. Should we decide to venture into deep space, and should it be populated with other forms of intelligent life, we would likely be facing an advanced species capable of interstellar travel and representing a technological capability at least as formidable as ours, if not greater. The optimist would wish for a peaceful first contact, but the realist would prepare for the worst. How much risk should humans take in hoping for the best outcome? The development of AP may be

the only way the human race would survive such an encounter with the advantages gained by a humanity equipped with Singularity-class capabilities.

The answer to this question and all of the other challenges posed by the novel capabilities presented in this chapter may prove elusive if sufficient preparation goes unmade. National policymakers have the responsibility to prepare our nation and the international community for success as the transition to a world with more capable AAI unfolds. Therefore, in the next chapter, this author will present a roadmap to develop a consolidated U.S. strategy for operationalization of AP to address formalization and adoption of this new instrument.

“Autonomous Power spawned from the human intellect, and therefore will always be fundamentally human.” (Frank Schreiber, 2014)

“The laboratory of war is similar to the laboratory of life, or any other worthwhile endeavor...a constant muddling through reality with the best possible model distilled from experience and study, frustrated by the novelty of change.” (Frank Schreiber, 2015)

Chapter 4: National Autonomous Power Strategy Recommendations

Autonomous Power Strategy

Two potential models for developing a strategy for adding AP as a core instrument of national power exist in the relatively recent publication of two cyberspace related documents. The first is the Comprehensive National Cyberspace Initiative (CNCI) and the second is the Department of Defense Strategy for Operating in Cyberspace. These two documents reflect substantive whole-of-government thinking in areas related to AP, but where threats posed by our adversaries represent a clear and present danger today. While AP threats are quickly emerging, cyber threats have been around since the 1971 release of the Creeper virus.¹ This author would caution against waiting to publish the nation’s first AP strategy 44 years from now since it may be overcome by unfortunate and catastrophic events in the decades prior.

First, the CNCI reflects outstanding work at the national level to elevate cyberspace to a level at which real and permanent advances in the cyber domain can be

¹ David Ferbrache, *A Pathology of Computer Viruses*. London: Springer London, 1992.

undertaken. It outlines a dozen long overdue sub-initiatives with “the ultimate goal of security cyberspace.”² Second, the Department of Defense Strategy for Operating in Cyberspace (DoDSOC) reflects the same kind of attention at the departmental level, but largely focused on the military instrument of national power. This author suggests a hybrid approach to formulate a Comprehensive National AP Initiative (CNAPI), borrowing from the aforementioned strategy documents. This CNAPI would borrow strategic guidance and whole-of-government staffing from the CNCI and consist of at least four initiatives modeled after those found in DoDSOC (see Table 4).

Table 4: Comprehensive National Autonomous Power Initiative

CNAPI Strategic Initiatives	Description
Initiative 1: Autonomous Power (AP) Instrumentation	Elevate AP to core U.S. instrument of national power to organize, train, and equip to take full advantage of AP potential.
Initiative 2: AP Concepts	Formulate new national AP strategy and operating concepts to conceive of, develop, and employ AP systems.
Initiative 3: AP Relationships	Build robust relationships with U.S. allies and international partners to strengthen collective AP capabilities.
Initiative 4: AP Workforce	Leverage the nation’s ingenuity through an exceptional AP workforce and rapid technological innovation.

The first initiative would formally elevate AP as a primary core instrument of national power enabling a host of subordinate activities across all of government, industry, and academia to organize, train, and equip the nation to take full advantage of AP’s unlimited potential. It would also likely result in the designation of a primary

² President Barak Obama, *Comprehensive National Cyberspace Initiative*, The White House, 2014. URL: <http://www.whitehouse.gov/issues/foreign-policy/cybersecurity/national-initiative>, accessed 21 Feb 2015.

department within the federal government to undertake a leadership role in AP development while coordinating the efforts of the other players. This author would recommend the Executive Branch's Department of Defense as the lead in any such an effort given its existing capabilities and the obvious classified military applications. The second initiative would direct the formulation of a 20-year AP strategy with associated operating concepts to conceive of, develop, and employ AP systems via a comprehensive and integrated approach across all entities aforementioned. This timeline remains consistent with current predictions as to the emergence of a Singularity so preparation for this eventuality would be prudent. The third initiative would direct the formulation of robust relationships with U.S. allies and select international partners to strengthen collective AP capabilities. With AP's implications related to the survival of humanity, this effort would be best served if conducted cooperatively in the international community with like-minded partners. The fourth initiative would direct investment to building and leveraging the nation's ingenuity through an exceptional AP workforce development program with emphasis on rapid technological innovation. One of the touchstone elements of this initiative would be the recruitment and development of people with the knowledge, skills, and abilities to lead the nation and the world through this transition.

Autonomists

As the opportunities and challenges of implementation of AP are great, the CNAPI requires people willing to commit their professional lives in getting it right. This author recommends that AP needs to be championed, codified and developed among other primary elements of national power via advocacy by a new generation of

“autonomists” capable of deftly navigating this terrain while conceptualizing and operationalizing novel ways of integrating this force-multiplying capability into our national aims. Like the diplomats, soft-powerists, warfighters, economists, and others who created valuable paradigms within which the other instruments of national power were developed, flourished and contributed to our growing national strength, so will autonomists build and nurture the foundations for autonomous power for our nation. Autonomists of various scientific, technological, engineering, mathematical, social, legal, ethical, and other liberal disciplines will specialize in key areas representing a whole-of-government approach to ushering the AP instrument into prominence. They will be imbued with the overriding imperative that whatever strategy, implementing, and operating concepts are created, they will represent the best humanity has to offer, and they will continue to reflect what must always remain a fundamentally human enterprise.

Fundamental Human Enterprise

On 10 Sep 2012, General Martin E. Dempsey (Chairman, Joint Chiefs of Staff) published the Commander’s Concept of Joint Operations (CCJO) to get the joint force thinking about new concepts of operation to counter increasingly diverse and dangerous adversaries. In the introduction, General Dempsey reminded the joint force that “even when waged with increasingly sophisticated technologies, the conduct of military operations remains a fundamentally human enterprise.”³ Despite what one might think, AP spawned from the human intellect and therefore will always be fundamentally human.

³ Department of Defense, Chairman of the Joint Chiefs of Staff, *Capstone Concept for Joint Operations – Joint Force 2020*, (Washington, DC: CJCS, 10 September 2012), URL: http://www.defenseinnovationmarketplace.mil/resources/JV2020_Capstone.pdf, accessed 1 Oct 2014, pg. 1

If AP fails to live up to expectations, it will be a direct result of the failure to afford it proper foresight and cautious development deserved of such a gift to humanity. When a Singularity arises, should that be the case, it would be wise for its forbearers to give it reason to protect its progenitor as a child would eventually be called upon to protect an aging parent.

Therefore, as an outgrowth of the human intellect, AP should reflect the state of the art regarding national and international legal, psychological, and ethical standards. No act by an AP entity should be carried out without the ability to conduct comprehensive processing to ascertain the most optimized legal, psychological, or ethical governance in any given situation. It is time to end the debate and get down to incorporating these elements into the AP equation. To assist in that effort, each of the scenarios below takes an excerpt from the CCJO and outlines strategy considerations that must be taken into account as the U.S. implements AP capabilities.

When describing the concept of globally integrated operations, the Chairman espoused the virtue of “seizing, retaining, and exploiting the initiative through operational campaign designs that enable the U.S. to decide and direct faster than our adversaries.”⁴ Well before the Singularity, AP will enable orders of magnitude increases in the speed of the decision loop by autonomously processing massive volumes of data on the operational environment. Seizing the initiative could theoretically be quickened through employment of ways and means exponentiating AAI combined with automatic pre-positioning of low density, high demand resources using AP’s capability for remote monitoring through unattended sensors dispersed throughout the world.

⁴ Ibid.

The chairman also acknowledged the value of “flexible, low-signature or small-footprint capabilities in cyberspace, space, special operations, global strike, and intelligence, surveillance, and reconnaissance.”⁵ Employing the same ways and means exponentiating features, AP capabilities will allow the joint force to maintain persistence across all of those domains with the advent of intelligent remote presence. AAI will serve as the ultimate force multiplier capable of adding additional super-human capital where human capital fails to meet the need.

The chairman finally extolled the virtue of joint operations being “increasingly discriminating to minimize unintended consequences.”⁶ AP will provide significant capability through autonomous identification of friend or foe (IFF). One of the most difficult problems for human operators is establishing and maintaining IFF and positive identification (PID) in the battlespace. AAI global presence IFF and PID will provide the Holy Grail of an unblinking eye capable of sustaining high-fidelity, long-duration pattern of life analysis from tactical to strategic targets. In fact, AAI may end up being more than human in ensuring the consistent elimination of unnecessary suffering.

Well-conceived AP solutions to all of these scenarios will ensure warfighting remains a fundamentally human enterprise.

⁵ Ibid.

⁶ Ibid.

Conclusion

This thesis explored the emerging phenomenon of AP, a combination of autonomy and national power. Since autonomy conveyed AI independent of human control, and national power conveyed the ability to influence others to secure a desired outcome, AP represented national power applied independent of human control. This thesis argued that AP deserves a seat at the table among the other primary instruments of national power and for the immediate development and implementation of a single consolidated U.S. strategy for operationalization of autonomous power at the highest intergovernmental level. The call for immediate implementation acknowledged the current state of affairs as being in relative turmoil due to unproductive debate as to the depth and breadth of application of autonomous AI systems (lethal and non-lethal) due to legal, psychological, and ethical considerations. This resulted in a substantial retardation in building the foundation for comprehensive employment of AP across the spectrum of peace and conflict. Continued delays in implementation of AP policy places our nation and the world at great risk.

Chapter 1 delved into the concept of national power and concluded by creating opportunity space for the emergence of a new element of national power, namely AP. Chapter 2 discussed the concept of autonomy, exploring AI, C2, and a future defined by an emerging Singularity. Chapter 3 revealed AP as an emerging element of national power consisting of the combination of autonomy and national power. It proposed a definition, described its features, and provided examples across the spectrum of peace and conflict. Finally, Chapter 4 recommended implementation of a Comprehensive National AP Initiative focused on ensuring AP retained qualities fundamental to a human

enterprise. It then proposed the adoption of a new specialization for autonomists to guide national efforts in managing the emerging element of AP.

At its core, this thesis was about ways and means exponentiation. To recap, when the strategy for applying ways and means outstrips desired ends, the resulting outcome is risk. AP, the fruitful combination of AI with national power, creates a method of producing ways and means at a scale unprecedented in human history, driving down risk. It provided insight into a method to accomplish all of the ends dictated by our core national interests and still possess a surplus of ways and means designated for accomplishing so many more altruistic endeavors.

In the not too distant future, humans will create a new AAI species that will eventually surpass humans in cognitive superiority. When that time comes, it will be comforting to know in the post-technological Singularity world, that this superior species learned the most important lessons of the last millennium from us about combating species depredation, would abhor speciesism, and would treat us with love and respect.

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Appendix A

First Annual JAWS Thesis Conference Transcript

Day 1 (9 Mar 2015) – Wargaming Suites 329

Panel 3B (1300-1445) – Theory of Future War

Autonomous Power – Transitioning from War to Peace in the I-Robot Millennium

Lt Col Frank Schreiber, Seminar 1

The year is 2035. Like her identical sisters, ALICE is orbiting 50 feet over blue water exactly 200 nautical miles east of her target, outside this nation's exclusive economic zone in international airspace. Her commander's intent (MIL) is to conduct kinetic and non-kinetic interdiction of any commercial shipping (ECO) leaving the target country she's monitoring, and broadcast the destruction live on global news feeds (INF). The tripwire for this interdiction mission is the target nation's failure to accept her government's diplomatic demarche (DIP), a window of opportunity which closed exactly one hour ago.

"A-lee-see De-gong-chi!" she extorts as this mission of destruction begins. For she, like her identical sisters, is ALICE, the Chinese Autonomous Lethal Interdiction Craft East, striking at the United States' east coast in a comprehensive and coordinated attack, and representing only 5% of the autonomous power capabilities used by China in this future scenario across all elements of national power.

In the scenario I just described, ALICE, autonomously recognized the expiration of a trigger point diplomatic initiative opportunity, conducted a lethal and non-lethal military mission, enacted severe economic consequences, and employed the information domain to capture the battle damage for live emphasis and historical posterity.

Good afternoon. I'm Lt Col Frank Schreiber and the title of my thesis is Autonomous Power: From War to Peace in the I-Robot Millennium. While this scenario may seem as fantastical as Alice in Wonderland, it is not implausible given the current state of affairs and expected progress over the next twenty years in the fields of artificial intelligence and autonomy.

Before I get too deep into the presentation, my lawyerly Seminar 1 professors advised me to take a brief moment to regale you with three compulsory statements before we delve into the meat of this thesis. So allow me to emphasize the mandatory requirements dictated by the rubric.

First, the research question I'm tackling is: Should autonomous power be elevated to a status equivalent to the other primary instruments of national power?

Second, my hypothesis is: The U.S. will benefit from immediate development of a single consolidated U.S. strategy for operationalization of autonomous power at the highest intergovernmental level.

Third, my primary recommendation is the formulation of a Comprehensive National Autonomous Power Initiative (CNAPI) with four strategic elements to enable development of that strategy.

The first question you may be asking is "What is autonomous power?" Autonomous power (AP) is the novel combination of autonomy and national power. Autonomy conveys artificial intelligence independent of human control. National power conveys the ability to influence others to secure a desired outcome. Therefore, autonomous power is the ability to influence others to secure a desired outcome via artificial intelligence independent of human control. Futurists agree that autonomous

artificial intelligence in the form of a Singularity (AI which exceeds human intellectual capacity and control) will likely occur in the 21st Century, with a median value of 2040.

Autonomous power manifests itself in two primary forms. The first is in the physical domain, and the second is in the cyberspace domain. When one thinks of autonomous artificial intelligence or AAI, we typically think of a robot, a drone, or some other physical object. The primary value of autonomous physical domain objects is the removal of human limitations on the object itself. For example, an unmanned object is theoretically more capable than its manned equivalent based on higher operational limits, such as g-forces, atmosphere, or time. As is represented by a great number of recently produced forms, these physical manifestations serve well in support of the military and economic instruments of national power. Why settle for a small percentage of Rambos per generation when you can create an entire force full of them. Why settle for something less than Six Sigma quality in industrial production when robots guarantee greater consistency. Over the next couple decades, the proliferation and cost of these systems will rise and fall, respectively.

Of course, each of these physical manifestations relies upon a central processing unit or brain to operate. However, unlike in a human, the brain need not be resident in the physical object. In fact, an object could have no collocated brain (such as in remote operations), one brain, or multiple brains (such as in virtual distributed operations). This illustrates the value of the second form, the cyberspace domain. AAI does not require a physical manifestation. One hyper-computer-server could host any number of AAI. The primary value of autonomy in the cyber domain is the virtually limitless replication of genius. Why settle for one Einstein or Kissinger in each generation when you can

produce an infinitesimal number of them. These Singularity-class AAI serve well across all instruments of national power. In my thesis, I explore applications such as national economic infrastructure protection, diplomatic strategizing, strategic messaging, and education but any number of complicated issues could be dealt with simultaneously. The complexity we complain about today when contemplating strategic planning hard problems will fall nicely into the job jar of AAI capabilities.

This combination of surpassing human limitations and near limitless replication give rise to the core benefit of autonomous power which is ways and means exponentiation. In the national strategic calculus, when the strategy for applying ways and means outstrips desired ends, the resulting outcome is risk. Autonomous power creates a method of producing ways (brain power) and means (applications) at a scale unprecedented in human history, driving down that risk.

So back to the research question: Should autonomous power be elevated to a status equivalent to the other primary instruments of national power? As you're aware Joint Publication 1 describes the primary instruments of national power as Diplomatic, Information, Military, and Economic with Financial, Intelligence, and Legal thrown in for good measure. The strongest of the elements, affectionately referred to as the DIME, not only convey the ability to secure a desired outcome on their own accord, but empower and strengthen the other instruments. Each of these four instruments benefit from servicing by three powerful department-level organizations and one bureau including the Department of State, Bureau of International Information Programs, Department of Defense, and Department of the Treasury. I argue that autonomous power

is at least as capable as any of the aforementioned primary instruments and has great potential to improve upon those instruments.

But these improvements will not occur if we do not take the lead internationally and execute a strategy for success. Powerful, emerging nation-states like China who would desire to counter U.S. traditional elements of national power already have a qualitative and quantitative advantage in autonomous power capabilities. In my thesis, I explore China's strength in drones and industrial robotics, but there are other areas where we've fallen behind our adversaries. Therefore, the Comprehensive National Autonomous Power Initiative I'm recommending first elevates autonomous power to a core U.S. instrument of national power to organize, train, and equip the nation to take full advantage of its potential. Next, it formulates new national autonomous power strategy and operating concepts to conceive of, develop, and employ these systems. Next, it builds robust relationships with U.S. allies and international partners to strengthen collection autonomous power capabilities. Finally, it leverages the nation's ingenuity through an exceptional autonomous power workforce and rapid technologic innovation.

This initiative reinforces that autonomous power spawned from the human intellect and therefore will always be inherently human. As such, it argues that autonomous power needs to be championed, codified and developed by a new generation of autonomists capable of deftly navigating the challenges while conceptualizing and operationalizing novel ways of integrating this force-exponentiating capability into our national aims. In the end, if ALICE will exist, we must ensure she and her sisters will be part of the cadre of U.S. national capabilities. AAI must be properly constructed and imbued with the same values, legal authorities, and social norms of a just human society

so they are capable of contributing equally with their natural counterparts in the defense of the nation.

Thesis Presentation Questions

1. The title of this thesis is Autonomous Power: From War to Peace in the I-Robot Millennium. What aspect of autonomous power enables the transition from war to peace?

A: There may eventually come a time when professional human warfighters are judged too valuable to sacrifice in warfare, but not AP warfighters. AP warfighters would undoubtedly eventually surpass the skill and effectiveness of even the best human warfighters, to the point of being able to execute successful operations and conduct war and warfare with entirely non-lethal methods. This would be the ultimate expression of an RMA. At its ultimate end, AP may be capable of rendering the entire human race incapable of harming itself. At that time, it will have enabled the transition from war to peace in the I-Robot millennium

2. If autonomous power entities are not controlled by humans, then how do we keep them from doing something counter to our national interest?

A: You touched upon a very interesting point. I would go as far as saying AP represents not just a revolution in military affairs (RMA), but a full-scale revolution in the affairs of man. It is fair to say every human on Earth presently embodies what can be considered autonomous natural intelligence. We trust that with the proper environment, education, and motivations, individual humans will make decisions and take actions that will contribute to achieving ends commensurate with national interests. We exert no more

control over individual citizens than simply providing a framework of social norms, including ethical and legal constraints, and the associated consequences for failing to abide by them. Properly constructed and imbued with the same values, legal authorities, and social norms of a just human society, AP systems will eventually be capable of contributing equally with their natural counterparts. The difference is that AP systems will also be able to rapidly adjust to changes in intent regarding ends, ways, and means without the lengthy assimilation modalities and variables of human comprehension and implementation. Simply put, AP systems will immediately act confidently, and in accordance with legal, ethical, and social norms all of the time, every time.

3. What is the greatest threat posed by autonomous artificial intelligence as we develop this technology?

A: As AP technology matures in the near-term and as we approach the Singularity in the long-term, there will be a palpable and understandable fear of it. If facilitated by future research and development (R&D), AP may eventually be capable of self-awareness and more importantly, self-replication, potentially applying orders of magnitude self-improvements based on consciousness of the flaws of its own design and capable of rampant self-optimization. In some scenarios, this could potentially place humanity at risk if R&D of AP is not conducted with extreme care. This is especially true if future generations of AP entities are not imbued with protocols to counter the idea that humans might be considered counterproductive, or worse obsolete. Since the U.S. cannot reliably and consistently control what other entities do with their AP capabilities, they should be considered in the same category as weapons of mass destruction given the potential catastrophic threat to human existence.

4. Are you advocating for replacing humans in warfare?

A: To be clear, this thesis is not a recommendation for the replacement of humans in warfare. In fact, most AP systems work best when combined with unique human qualities not yet reproducible in AAI. However, there may be a time in which humans no longer provide a value-added in warfare, and at that time, it would be wise to re-evaluate their participation. Interestingly, AP applications related to the military instrument of power represent only a fraction of those conceivable. The majority of AP capabilities will function during peacetime across all of the other instruments of national power.

5. Following up on that last question, could you provide an example of autonomous power use in something other than the military instrument of power?

A: AP capabilities could be applied to the desperate national need for highly qualified teachers in primary, secondary, and advanced education. Development of an education-focused AAI virtually replicated on an industrial scale and delivered to the individual desktop would revolutionize education. Rather than centrally delivering lowest-common denominator education via the one-on-many mode common in contemporary educational settings (one teacher, multiple students), AAI could deliver many-on-many personalized education to each individual at their own pace and capability (one/many teacher(s) for every student). AAI of this type would be available any time of day to overcome personal scheduling challenges and could be accessed from home, educational centers, or personal mobile devices. As we all know, education is one of the best ways influence others to secure a desired outcome.

Vita

Lieutenant Colonel Schreiber is a native of Florida, and graduated from Miami Beach Senior High School, Miami Beach, FL., in 1985. He earned an AS in Intelligence Collection from the Community College of the Air Force, Maxwell AFB, AL. in 1991, a BS in Management from NOVA Southeastern University, Fort Lauderdale, FL., in 1994, an MS of Public Administration from Auburn University, Montgomery, AL, in 1999, and an MS of Strategic Intelligence from the National Intelligence University, Defense Intelligence Agency, Bolling AFB, Washington, D.C. in 2000.

Earning a regular commission in May of 1996 as an honor graduate from Officer Training School, he is a career intelligence professional and regional affairs strategist with a background of over 3,300 hours (850 combat hours) in various command, control, intelligence, surveillance and reconnaissance aircraft. He is a veteran of Operations JUST CAUSE, DESERT SHIELD, DESERT STORM, DESERT CALM, IRAQI FREEDOM, ENDURING FREEDOM, and NEW DAWN and served in intelligence, surveillance, reconnaissance, command and control, and flying organizations at squadron, group, wing, agency, Air Staff and Defense Department levels. He is a graduate of the Air Force Squadron Officer School, Marine Corps Amphibious Warfare School, and was an Air Force Intern in the Offices of the Secretary of the Air Force and Secretary of Defense. He is married and has two children.

His most recently served as commander of the Signals Analysis Squadron, National Air and Space Intelligence Center, Air Force Intelligence, Surveillance, and Reconnaissance Agency. He led over 250 military, civilian and contractor personnel providing predictive intelligence for policymakers, warfighters, and the acquisition community. He will be reassigned to the Joint Enabling Capabilities Command upon graduation.