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ABSTRACT

Research and development into drone technology has exploded in the United States in the recent decades. From the operation of killer drones in the military to agricultural survey drones in farms, the proliferation of drone technology is well on its way to radically altering the American future. However, there remains numerous laws, policies, and regulations that place stifling restrictions on drone development and operations in America. Halfway across the world, China has also begun to experience the "drone revolution," but with its relatively laxer laws regarding both commercial and public drone operations and manufacturing, it seems poised to surpass the United States in not only drone R&D, but drone export as well. In recent years, China has expanded to become "a prolific developer and no-questions-asked exporter of UAVs" selling to a plethora of nations ranging from Saudi Arabia to Pakistan and Nigeria.[1] Domestically, China has relied firmly on indigenous production and R&D since the 1980s to expand its UAV technologies, expanding its UAV industry to include a variety of defense firms as well as academic research groups.[2] However, China's drone program is not without its own issues and setbacks, forcing the Civil Aviation Administration of China (CAAC) to issue new drone regulations to be implemented on a trial

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1. Adam Rawnsley, *Meet China's Killer Drones*, FOREIGN POLICY (January 14, 2016), http://foreignpolicy.com/2016/01/14/meet-chinas-killer-drones/.

2. Kimberly Hsu, *China's Unmanned Aerial Vehicle Industry*, U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION (June 2013).

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basis. This paper will analyze and compare the two comprehensive UAV regulations—the stricter FAA regulations and the newer UAV regulations promulgated by the CAAC—and explore the differences between the two regulatory policies (both commercial and military), their benefits and drawbacks, and attempt to present solutions as to how the CAAC and the FAA can help build an initial framework for other nations to follow.

INTRODUCTION

Since its post-Mao entry into the international market, China has vaulted into the heights of economic giants. Currently, one of its largest sectors undergoing massive levels of research and development (R&D), production, export controls, and operations regulation is its drone[3] industry. Although certain studies have predicted that China's technology sector will not be a prime competitor against the United States for decades,[4] the combined power of foreign funding and China's private civilian industry, academia, and military[5] in advancing the UAV industry threatens to disprove this notion. The resourcefulness of these various sectors allows China to easily offer cheaper alternatives to American-made UAVs. Consequently, China now stands as the largest sole competitor to the United States in a majority of sectors in the UAV industry, ranging from export and production to R&D to drone operations policies.[6] Despite various concerns that China's rise threatens the American drone industry and vocal criticism of its relatively unregulated drone exports, China's recent actions have revealed its willingness to cooperate in the field of international exports regulation. Several newly adopted policies and export regulations have shown a China that may have realized its place in the UAV industry as an essential ally helping the United States affect positive change in the realm of UAV operations regulations and international export controls.

This paper seeks to undertake a comparative study of China's and the United States' drone sectors, specifically detailing their distinct histories of UAV

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3. The author will use "drone" and "UAV" (unmanned aerial vehicle) interchangeably for the purposes of this paper.

4. *See* MICAH SPRINGUT ET AL., CHINA'S PROGRAM FOR SCIENCE AND TECHNOLOGY MODERNIZATION: IMPLICATIONS FOR AMERICAN COMPETITIVENESS 8 (2011) ("China has yet to show that it can meaningfully use the tools of the state to drive the commercialization of discoveries in research labs in a competitive manner.").

5. *See* Daniel Houpt, *Civilian UAV Production as a Window to the PLA's Unmanned Fleet*, 12 CHINA BRIEF, Feb. 21, 2012, at 6, https://jamestown.org/program/civilian-uav-production-as-a-window-to-the-plas-unmanned-fleet/.

6. *See* TATE Q. KRASNER, ASSESSING CHINA'S UNMANNED AERIAL VEHICLES (S. Rajaratnam Sch. of Int'l Studies 2014); Becca Schwarz, *China: The World's Drone Superstore*, FOREIGN AFF. REV. (Apr. 28, 2016), http://foreignaffairsreview.co.uk/2016/04/drone-2/.

development and production, their distinct operations regulations for commercial UAV and the differences in their international export policies regarding military-grade, weaponized UAVs. There is a clear distinction between the U.S. commercial and military drone production, with heavy domestic regulation governing commercial drone operations and strict self-regulation and international parameters for exports of weaponized UAVs. Conversely, in China, the fluidity and cooperation in its complex academia-civilian-military UAV industry, coupled with less rigid regulations, has pushed drone research, production, and export (both commercial and military) to the next level. The paper will then analyze the consequences of such rapid Chinese advancements in the domestic and international UAV industry and the role the United States plays in this expansion. Finally, I will offer some conclusions and potential solutions as to how the United States and China, as emerging leaders in the international UAV industry, can and should spearhead Sino-U.S. cooperation to better international export controls on weaponized UAVs and draw from each other's commercial drone operations regulations to increase the efficiency of their respective operations policies. This will ensure that other nations interested in developing their own commercial and military UAV regulations through their civil aviation authority will have a well-functioning operational blueprint to lay an initial framework, as exemplified by those of the EU, Japan, and the ACP Countries (Asia, Caribbean, and Pacific Group of States).

I. A TALE OF TWO GIANTS

A. The American Story

The United States' interest in UAVs first originated in the military, beginning during World War I and continuing into the era of modern military technology. UAV technology remained quite antiquated through the Vietnam War, as it was primarily based on manned aircraft and used only for military reconnaissance and surveillance. In the 1970s, the U.S. military began contracting private corporations to produce more advanced UAVs.[7] This trend would continue through today; at the end of the First Gulf War, the Department of Defense (DoD) contracted General Atomics to build the Predator, one of the most recognized of today's weaponized UAVs. After decades of testing, the U.S. government finally recognized UAVs as a fully-fledged program worthy of full-time funding in the 1990s. Since then, the U.S. production of military UAVs has only gone on the upward swing.

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7. JOHN DAVID BLOM, UNMANNED AERIAL SYSTEMS: A HISTORICAL PERSPECTIVE, 68–70 (2010). A 1970 Air Force and National Security Agency joint venture to develop a UAV with electronic signals intelligence capability eventually awarded contracts to Boeing and Ryan Aeronautical Company. In 1975, Lockheed Missiles and Space Company, a part of Lockheed Martin, was contracted to help the Army develop the Aquila, a UAV capable of providing laser designation for precision munitions.

The government's drone purchases saw a dramatic spike over the last few years, with defense spending on UAVs at nearly $14 billion over the last five years, peaking in fiscal 2012.[8] Although the proposed Unmanned Aircraft System (UAS) budget for the 2017 fiscal year, at approximately $4.457 billion, is slated to be lower than that of 2016, it has remained around the $4 to $5 billion range for the last few years, and looks to only continue to do so thanks to a combination of public and private investment into the UAV industry. The close-knit relationship between private corporations and the military in production of military UAVs, however, has led to a pigeonholing of innovation and development in the U.S. military UAV sector. Because of various export regulations and the secretive nature of the U.S. military, contracts for military-grade, weaponized UAVs are generally limited to a handful of corporations, typically General Atomics (Predators and Reapers), Lockheed Martin, or Boeing. This has continued a trend that has plagued U.S. UAV development since the 1970s—deep-pocketed contractors demanding unreasonably high costs coupled with timely development and production delays. The Aquila system started development under Lockheed in 1975, and initial costs had doubled to $1.6 billion in 1982. By 1987, this problem continued, with only seven of the 105 test missions fulfilling requirements. The Army ultimately scrapped the Aquila program despite pouring millions into the budget. Although it would not pursue such similar mistakes later down the line, the government still continued its reliance on a small number of these corporations in development of military UAVs. This continued the trend of time delays and development and production overages,[9] ultimately resulting in sometimes malfunctioning, high-cost UAVs that cannot hold up to their international competition. Despite these issues, the U.S. military UAV industry continues its steady growth, with many of these

8. MARKET VIEW: UNMANNED AERIAL SYSTEMS IN DEFENSE 5 (2016), http://www.govini.com/wp-content/uploads/2016/04/Govini_Unmanned_Aerial_Systems_Defense.pdf.

9. The USAF the MQ1/9 Predator and Reaper acquisition program in 2002, contracting General Atomics to build the armed UAV systems. In 2006, the Air Force estimated the program would cost $3.75 billion, which has jumped to $10.75 billion by 2012. In 2015, Col. William S. Lester, program manager of the acquisition program, spoke about the program, stating that "there are bound to be insidious artifacts lurking in the system that we missed; some may be significant." This proved to be true, with the latest generation of the Reaper being incapable of hot wef operations and plagued with mid-flight loss of electrical power. Dan Gettinger, *Drone Spending: The MQ-9 Reaper*, CTR. FOR THE STUDY OF THE DRONE AT BARD C. (Oct. 12, 2015), http://dronecenter.bard.edu/drone-spending-the-mq-9-reaper/. *See generally* DEP'T OF DEF., PERFORMANCE OF THE DEFENSE ACQUISITION SYSTEM 2015 ANNUAL REPORT (2015), https://admin.govexec.com/media/gbc/docs/pdfs_edit/performance-of-defense-acquisition-system-2015.pdf; Craig Whitlock, *More Air Force Drones are Crashing Than Ever As Mysterious New Problems Emerge*, THE WASH. POST (Jan. 20, 2016), https://www.washingtonpost.com/news/checkpoint/wp/2016/01/19/more-u-s-military-drones-are-crashing-than-ever-as-new-problems-emerge/?utm_term=.b87155c0e113.

private corporations involved in the military UAV industry branching out into separate civilian commercial UAV production as well.

Although UAVs have been produced by the U.S. military since the 1950s, their rapid expansion into the civilian, private market has been a modern phenomenon of the last two decades. The FAA grossly underestimated the sudden growth of the drone industry when, in 2010, it estimated that by 2020 there would perhaps be over 15,000 civilian drones in the country.[10] In its most recent aviation forecast, the FAA estimates that combined total hobbyist and commercial UAV sales will rise from 2.5 million in 2016 to 7 million in 2020.[11] A majority of these civilian and commercial drones are produced by companies that initially were involved with the development and production of weaponized military drones. General Atomics, Northrop Grumman, and Lockheed Martin are among a few large corporations that have cornered the U.S. commercial drone production market.

The rise in drone production in the United States has also been in large part thanks to the political-industrial complex started by the Congressional Unmanned Systems Caucus. Formed by a small group of congressional representatives from districts with drone industries, the Caucus soon gained traction and reached up to sixty members by late 2012.[12] Their goal was to "educate members of Congress and the public on the strategic, tactical, and scientific value of unmanned systems; actively support further development and acquisition of more systems, and to more effectively engage the civilian aviation community on unmanned system use and safety."[13] The Caucus managed to bring about drone proliferation by channeling earmarks to different UAV-producing corporations such as General Atomics, pushed the Department of Homeland Security (DHS) to establish a major drone program, and increased the annual DoD and DHS budgets for drone R&D and procurements. On top of political maneuvering, the Caucus partnered with the Association of Unmanned Vehicle Systems International (AUVSI), an industry group that brings together the leading drone manufacturers and universities with UAV research projects.[14] AUVSI has an annual operating budget of $7.5 million, with $2 million a year set aside for conferences and trade shows encouraging

10. *Welcome to the Drone Age*, THE ECONOMIST (Sept. 26, 2015), http://www.economist.com/news/science-and-technology/21666118-miniature-pilotless-aircraft-are-verge-becoming-commonplace-welcome.

11. *The Future of Commercial Drone Use*, INS. J. (Mar. 29, 2016), http://www.insurancejournal.com/news/national/2016/03/29/403149.htm.

12. Yasmin Tadjeh, *New Senate Unmanned Aerial Vehicle Caucus to Tackle Privacy Issues*, NATIONAL DEFENSE (Dec. 1, 2012), http://www.nationaldefensemagazine.org/articles/2012/11/30/2012december-new-senate-unmanned-aerial-vehicle-caucus-to-tackle-privacy-issues ("The House Unmanned Systems Caucus, formed in 2009, includes 60 members, and is led by Reps. Buck McKeon, R-Calif., and Henry Cuellar, D-Texas . . . .").

13. TOM BARRY, DRONES OVER THE HOMELAND: HOW POLITICS, MONEY AND LACK OF OVERSIGHT HAVE SPARKED DRONE PROLIFERATION, AND WHAT WE CAN DO, 1, 7 (2013), https://www.ciponline.org/images/uploads/publications/IPR_Drones_over_Homeland_Final.pdf.

14. *Id.* at 8.

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12. Yasmin Tadjeh, *New Senate Unmanned Aerial Vehicle Caucus to Tackle Privacy Issues*, NATIONAL DEFENSE (Dec. 1, 2012), http://www.nationaldefensemagazine.org/articles/2012/11/30/2012december-new-senate-unmanned-aerial-vehicle-caucus-to-tackle-privacy-issues ("The House Unmanned Systems Caucus, formed in 2009, includes 60 members, and is led by Reps. Buck McKeon, R-Calif., and Henry Cuellar, D-Texas . . . .").

13. TOM BARRY, DRONES OVER THE HOMELAND: HOW POLITICS, MONEY AND LACK OF OVERSIGHT HAVE SPARKED DRONE PROLIFERATION, AND WHAT WE CAN DO, 1, 7 (2013), https://www.ciponline.org/images/uploads/publications/IPR_Drones_over_Homeland_Final.pdf.

14. *Id.* at 8.

various government agencies and companies to use unmanned systems. In response to the U.S. UAV industry's quick pace of expansion, the government has adapted several domestic operational regulations and international export agreements, albeit at a potential economic cost.

B. Attempt at Self-Regulation

Following upsurge of commercial UAV numbers, the FAA was hard-pressed to come up with policies and regulations that would ensure public safety while advancing the use of drones into everyday life. [15] In its attempt to cover such a broad spectrum of UAVs, the FAA passed Part 107, which lays out comprehensive rules for drone operations, drone pilot qualifications and certifications, and aircraft requirements. This policy only applies to nonhobbyist, commercial drones weighing under fifty-five pounds and not to any individual or hobbyist merely attempting to fly a model airplane.[16] The FAA's new UAV regulations have led to an increase in those registering their drones[17] and in those registering for exemptions.[18]

Additionally, the introduction of Part 107 has changed certain aspects of civilian commercial drone usage in the United States. Previously, the FAA had required any for-profit, commercial drone operation to be piloted by an individual carrying a pilot's license. This placed undue burdens on these operations, including precious time and cost of pilot licensing. With the new Part 107 rules, the required pilot's license has been replaced with a mandatory drone flight certification and knowledge test. This allows companies and commercial drone operators a much cheaper, faster, and direct method to reap the benefits of the drone revolution. The loosening of pilot certification under Part 107 and introduction of waivers[19] have

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15. Larry Downes, *What's Wrong with the FAA's New Drone Rules*, HARV. BUS. REV. (Mar. 2, 2015), https://hbr.org/2015/03/whats-wrong-with-the-faas-new-drone-rules ("In fact, the FAA had originally promised the rules by 2011, but it proceeded to miss every deadline it set for itself, as well as those established by Congress.").

16. 14 C.F.R. § 107.1 (2016).

17. As of February 2016, U.S. drone registration numbers hit 325,000 registered users, more than the 320,000 piloted aircraft registered with the FAA. Keith Laing, *Feds: 325K Drones Now Registered*, THE HILL (Feb. 8, 2016, 3:08 PM), http://thehill.com/policy/transportation/268644-feds-325k-drones-now-registered; Jonathan Vanian, *More Drones Are Now Registered With the Government Than Airplanes,* FORTUNE (Feb. 8, 2016), http://fortune.com/2016/02/08/more-registered-drones-than-airplanes/.

18. *See The Future of Commercial Drone Use*, *supra* note 11, ("As of mid-March [2016], the FAA has issued more than 4,000 . . . exemptions to insurers and organizations for commercial drones to operate in the national airspace, which the agency said demonstrates 'considerable potential demand for UAS operations, in low-risk, controlled environments.'").

19. The FAA has also introduced waivers to § 107, allowing certain emergency UAV operations at nighttime such as search and rescue or firefighting. *See generally* John D. Goetz et al., *Key Issues and Insights for Transportation and Energy Companies Regarding*

also opened up various benefits of drone operations in fields such as surveying, construction, infrastructure maintenance, and natural disaster responses. However, one of the main economic sectors that can heavily benefit from drone operations, but unfortunately is neglected by FAA's regulations, is commercial delivery. Because of the strict regulations of maintaining constant visual line of sight (VLOS), having flights only during the day, and observing severe weight limitations (of under fifty-five pounds), U.S. policies on commercial UAVs have alienated a potentially massive source of economic funding in the commercial delivery industry.[20] As commercial companies begin turning to nations with more flexible regulations on UAV deliveries, the U.S. UAV industry faces another economic setback with regard to exports of military UAVs, this time as a result of both international agreements and a strict self-regulatory export policy.

Although the United States has been developing, using, and sometimes exporting weaponized drones[21] for quite some time, it has not been bound by many regulations specifically targeted toward policing armed UAVs. The closest form of international regulation that the United States has signed dealing with armed drones is the 1987 Missile Technology Control Regime (MTCR), an agreement on regulating nuclear-capable missiles and technology. The MTCR placed some restrictions on certain drone exports,[22] but, as a voluntary export control, was ultimately insufficient to govern and regulate the rapid expansion of weaponized UAVs into other nonsignatory states. There are only a handful of other regulations that the United States follows in terms of international drone export controls. The International Traffic in Arms Regulations (ITAR) allows the United States to have strict controls on the export of military drones, requiring authorization from the Department of State for any U.S. citizen wishing to export weapons or defense

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Commercial Drone Operations, JONES DAY 6 (July 2016), http://www.jonesday.com/files/Publication/954642fc-a95b-4d89-ae6d-96fee9ff8e32/Presentation/PublicationAttachment/ec33fc0d-f859-4598-a55f-a516fdc405f6/Key%20Issues%20and%20Insights%20for%20Transportation.pdf.

20. The FAA has also introduced waivers to § 107, allowing certain emergency UAV operations at nighttime such as search and rescue or firefighting. *See generally* John D. Goetz et al., *Key Issues and Insights for Transportation and Energy Companies Regarding Commercial Drone Operations*, JONES DAY 6 (July 2016), http://www.jonesday.com/files/Publication/954642fc-a95b-4d89-ae6d-96fee9ff8e32/Presentation/PublicationAttachment/ec33fc0d-f859-4598-a55f-a516fdc405f6/Key%20Issues%20and%20Insights%20for%20Transportation.pdf.

21. Up until 2015, the U.S. had historically sold armed UAVs only to England. Missy Ryan, *Obama Administration to Allow Sales of Armed Drones to Allies*, THE WASH. POST (Feb. 17, 2015), https://www.washingtonpost.com/world/national-security/us-cracks-open-door-to-the-export-of-armed-drones-to-allied-nations/2015/02/17/c5595988-b6b2-11e4-9423-f3d0a1ec335c_story.html?utm_term=.ad35c583176a.

22. The MTCR carries a "strong presumption of denial" for export of Category I UAVs that are "capable of delivering a payload of at least 500 kg to a range of at least 300 km." *Frequently Asked Questions (FAQs)*, MISSILE TECH. CONTROL REGIME, http://mtcr.info/frequently-asked-questions-faqs/ (last visited Dec. 11, 2017).

services to a foreign buyer. The Export Administration Regulations (EAR) regulate commercial dual use UASs that are not governed by ITAR, requiring certain licenses before dual use UAVs can be sent to specified locations. Further regulations on American exports of dual-use UAVs are covered under the Wassenaar Arrangement, a multilateral export control regime.[23]

As one of the founding members of the MTCR and a key player in the UAV industry, the U.S.'s aversion to the proliferation of armed drones has evolved into a longstanding and relatively stable self-regulation of military drone exports. Even when using drones to aid legitimate conflicts overseas, the United States prefers to fly its own missions alone, and hold sole accountability and responsibility for operation of the UAV.[24] When it comes to sales of weaponized UAVs, the United States has only sold drones to the United Kingdom and France,[25] but in February 2015, the Obama administration loosened the historically strict policies to allow for international exports of certain U.S. military and commercial UAVs. Despite being a massive policy shift, the new policy still takes cues from previous regulations, specifically maintaining "the United States' long-standing commitments under the MTCR."[26] The international sale of a military UAV through a direct sale between a U.S. contractor and foreign government is still prohibited. Instead, the new policy promotes the government-to-government security assistance as per the Arms Export Control Act (AECA) by using the Foreign Military Sales (FMS) program. Approved foreign end users will have to provide certain assurances and agree to end-use monitoring by the U.S. government, allowing the United States greater control over our UAV exports even after they have left the country.

This is a boost for American drone production and export, as the United States is finally able to enter the international market without the heavy restrictions seen a few years before.[27] The previously mentioned time delays and increasing costs of

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23. KIMBERLY HSU ET AL., U.S.-CHINA ECON. & SEC. REVIEW COMM'N, CHINA'S MILITARY UNMANNED AERIAL VEHICLE INDUSTRY 15 (2013).

24. The Nigerian government has enlisted the aid of U.S. drones to track down Boko Haram bases. However, these drones and the missions are all carried out by American personnel, The U.S. embassy then gives sensitive information to the Nigerian army, which is then handed over to the government for evaluation. A similar relationship exists in both Pakistan and Jordan. *See* Frank Sieren, *Sieren's China: The Fight for the Unmanned Drone Market*, DEUTSCHE WELLE (Sept. 22, 2015), http://p.dw.com/p/1Ga9n.

25. The sale of armed drones to England was conducted in June 2007, and to France in August 2013. *See* Micah Zenko, *The Great Drone Contradiction*, FOREIGN POL'Y (Feb. 19, 2015, 9:11 PM), http://foreignpolicy.com/2015/02/19/the-great-drone-contradiction-unmanned-aircraft-systems/?wp_login_redirect=0.

26. Office of the Spokesperson, *U.S. Export Policy for Military Unmanned Aerial Systems*, U.S. DEP'T OF ST. (Feb. 17, 2015), https://2009-2017.state.gov/r/pa/prs/ps/2015/02/237541.htm.

27. Not long after the announcement, the U.S. began approving military drone sales to the Netherlands ($339 million sale of MQ-9 Reapers), Japan (3 Global Hawks at $1.2 billion), and Spain ($243 million deal MQ-9 Reaper Block 5s). *See* Caitlin Lenzner-White, *Missing Out on the Drone Market*, U.S. NEWS & WORLD REP. (May 11, 2016, 9:00 AM),

production and development of American UAVs have resulted in extremely high-cost systems, reducing the economic presence of American drones in the international market. As such, the United States is entering an international drone market rapidly being cornered by China, which has found itself "in the unique position of having a thriving UAV industry with only a few export restrictions."[28]

C. Three-fold Industry

Although the emerging Chinese UAV sector has always been a few years behind its U.S. counterpart, it has also seen a sudden surge in field-wide development, production, export, and regulations within the past few years. Unlike the U.S. industry, which is primarily based around private industry and the military, the Chinese UAV industry enjoys the benefits of a strong, well-established bond[29] between foreign private industry, state-owned enterprises (SOEs), academia, and the government (specifically, the People's Liberation Army[30]). Technological research and production for UAVs are largely state-funded in China, reflecting Beijing's attempts to rival and even outpace the level of research, production, and export of the American UAV industry.[31] This includes both the development and production of military UAVs, as well as that of private, commercial UAVs for aid

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http://www.usnews.com/opinion/articles/2016-05-11/the-us-should-relax-its-export-policy-on-drones-to-compete-with-china.

28. Krasner, *supra* note 6, at 25.

29. *Id.* at 16.

30. *See* MICHAEL S. CHASE ET AL., EMERGING TRENDS IN CHINA'S DEVELOPMENT OF UNMANNED SYSTEMS (2015) ("China's focus on unmanned systems is at least partially attributable to their potential utility in maritime territorial disputes, but unmanned systems could also be useful to China's military in a range of other contingencies, including domestic disaster relief operations.").

31. China as increased UAV research in the recent years faster than any other country, and now every major manufacturer for the Chinese military has a research center devoted to unmanned systems. The presence of Chinese drone companies in international deals, such as the one between Lufthansa and DJI in early 2016, serves to show the heightened pace of China's commercial UAV sector as well. *See* DEFENSE SCI. BD., DEP'T OF DEFENSE, TASK FORCE REPORT: THE ROLE OF AUTONOMY IN DOD SYSTEMS 69 (2012), https://fas.org/irp/agency/dod/dsb/autonomy.pdf; *China Drone Manufacturers and Industry Taken Off in Space 2016*, CHINA CHAMBER OF COM. IN THE NETH. (Mar. 15, 2016), https://www.dccchina.org/2016/03/china-drone-manufacturers-and-industry-taken-off-in-space-2016/.

in domestic disaster relief operations,[32] monitoring the environment,[33] and advancing imaging systems and communications technology.[34]

There are several glaring drawbacks to the copious government funding, the least of which include "serious problems of research creativity . . . weak accountability for research expenditures, troubled institutional arrangements . . . and a serious undersupply of highly qualified scientists and engineers."[35] Other oft-cited issues include "'administrative interference with academic research,' a 'lack of fairness' in the selection of projects, gaps between promises and achievements, and numerous instances of fraud and deception."[36] The detrimental effects of these issues are largely ameliorated, however, by the support of private enterprises, specifically Western nations hedging their bets behind China's UAV industry. As these foreign entities[37] continue to embed themselves within China's innovation system, they serve as pools of innovation and investment potential that lend a hand to the sudden, but immense, growth of the UAV industry in China.[38] China has also actively engaged in gathering foreign technology to promote its UAV innovation. While this commonly involved reverse engineering technology, China in the recent years has turned to studying open source material and debriefing visiting U.S. drone experts attending UAV conferences and meetings in China.[39] This in turn attracts even more foreign private interests into funding China's burgeoning UAV industry. However, the Chinese UAV industry does not stand on the aid of foreign private investment alone.

The PLA's funding into the civilian industry plays another pivotal role in the surge of China's UAV R&D and production in the past few years. In 2011, China's defense white paper noted, "civilian enterprises now account for two-thirds of licensed entities researching and producing weapons and other defense goods."[40]

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32. Beijing approved the use of drones built by the Chinese Academy of Sciences Institute of Remote Sensing Applications to image earthquake-stricken areas in Lushan in 2013. *See* CHASE ET AL., *supra* note 30, at 6.

33. The Ministry of Environmental Protection has been using drones to monitor industrial polluters in Beijing, Shanxi, and Hebei. *See id.*

34. At least 15 teams are set up at major universities and research institutes to conduct research on unmanned systems with a dramatic surge in government funding, coming mainly from the PLA. Key research areas reportedly include development of imaging systems and communications technology. *See id.* at 3.

35. Springut et al, *supra* note 4, at 10.

36. *Id.* at 33.

37. As Springut reports, this includes foreign corporations, universities, and scientists seeking mutually beneficial partnerships with Chinese entities. *Id.* at 12.

38. *See infra* Part II for more on Western investment. *See also* Douglas MacMillan & Jack Nicas, *After Fresh Investment, Chinese Drone Maker DJI Valued at About $8 Billion*, WALL STREET J. (May 6, 2015, 11:43 PM), http://www.wsj.com/articles/chinese-drone-maker-dji-raises-75-million-from-accel-partners-1430915407.

39. Edward Wong, *Hacking U.S. Secrets, China Pushes for Drones*, N.Y. TIMES (Sept. 20, 2013), http://www.nytimes.com/2013/09/21/world/asia/hacking-us-secrets-china-pushes-for-drones.html?_r=1&.

40. *See* Houpt, *supra* note 5, at 4, 7.

This was due in part to China's ongoing effort to promote civil-military integration (CMI) in its development of UAV technology.[41] As such, an increasing number of SOEs and PLA-funded private enterprises are producing UAVs that, "while ostensibly for civilian purposes, have clear military applications."[42] Unlike Lockheed Martin and the other private companies in the American drone market, many Chinese companies involved in the UAV industry are either partially or entirely state-owned, allowing the government to use the industrial base to exploit domestic manufacturing and utilize the public-private partnership.[43]

Because many of these civilian-purposed UAVs have clear alternate military potential,[44] overall production of UAVs in China is at an all-time high and only seems to keep growing. The academia's involvement in the R&D and production of the UAV industry is the last piece of China's UAV industry. Unlike the U.S. military-industrial-based UAV industry, China relies on its primarily government-funded academia "for insight into potential technological and operational capabilities of UAVs."[45] This continues the trend of promoting CMI, widening the research and production base of UAVs. The Chinese government funds UAV research through two major academic groups, Project 863 and the National Natural Science Foundation of China (NSFC). These groups then go on to fund programs, studies, and reports throughout Chinese universities. The Nanjing University of Aeronautics and Astronautics (NUAA), for example, houses the Unmanned Aircraft Vehicle Research Institute and College of Automation Engineering and receives over 10 million yuan each year from Project 863, NNSF, and Project 973—a related science fund.[46] With such dedicated state-funding, the academia is dictated a key role in the research portion of the UAV industry. In connection with the civilian-military industry,[47] the academia has worked to boost the production and export of Chinese-made UAVs to unprecedented heights.

As more and more UAV developments and innovations arise from this CMI, China aims to further its production levels by turning to international exports of both weaponized and commercial UAVs. The China National Aero-Technology

41. Krasner, *supra* note 6, at 15.

42. Houpt, *supra* note 5, at 7.

43. *Id.* at 8.

44. The CASL SL-200 is a high-altitude UAV marketed for agricultural uses, but has "'a stealthy design capable of carrying out a very diverse payload,' giving some pause about its intended use. Additionally, one of China's largest UAV companies, ASN Technology Group, has created the ASN-211, a lightweight drone used for weather detection and search and rescue missions. Based off these designs ASN has also developed a military Reconnaissance and Precise Attach UAV that can "find and destroy time-sensitive targets immediately." *Id.*

45. *Id.*

46. *Id.* at 6.

47. The Aviation Industry Corporation of China (AVIC), an SOE, hosted the International UAV Innovation Grand Prix in September 2011, drawing entrants from a number of Chinese universities. Participants were to design and create UAVs that could automatically take off, cruise, and land on the deck of a simulated aircraft carrier. *Id.* at 7.

Import and Export Corporation (CATIC) has featured UAVs at overseas exhibits in the UAE, Singapore, and France, while other companies have looked into international export options through domestic exhibits. China's expansive UAV industry has also allowed it to create and sell weaponized UAVs at unparalleled low costs. Although this has created an economic boon for China, the international export of weaponized Chinese UAVs has led some to have misgivings about who receives these UAVs.[48] Realizing its leading position as one of the main international producers and exporters of weaponized and commercial UAVs, China has implemented several commendable operations policies and export controls to reflect its new status.

D. Old Dog, New Tricks

Although China seems to be overall less strict on its regulation of the UAV industry, they continue to retain several FAA-esque policies intended to ensure the public safety in today's drone-filled society. The *Provisions for the Operation of Light and Small Unmanned Aircraft (for Trial Implementation)* were issued by the Civil Aviation Administration of China (CAAC) on December 29, 2015, and aimed to define "what qualifies lawful operation, with the aim of normalizing the authorized flying of UAS and preventing the unauthorized flying of UAS."[49] Unlike Part 107, which regulates commercial uses of drones under fifty-five pounds, the CAAC provisions classify UAVs into seven categories, the first four of which are based on weight (running from under 1.5 kg to 150 kg) and the other three on their operational usage.[50] In allowing operations of UAVs weighing up to 300 pounds (albeit with certain restrictions), the CAAC regulations have opened up countless innovative possibilities from UAV producers and operators in terms of flight capabilities, technologies, and operations. The restrictions on several categories of UAVs also introduce useful geo-fencing and operational updates,

48. Because China tends to be extremely secretive and protective of its clients, there have been concerns as to the potential for misuse and abusive use of these armed drones. *See* Adam Rawnsley, *Meet China's Killer Drones*, FOREIGN POL'Y (Jan. 14, 2016, 4:56 PM), http://foreignpolicy.com/2016/01/14/meet-chinas-killer-drones/.

49. Jun Wei et al., *China Launches First Operational Rules for Civil Unmanned Aircraft*, HOGAN LOVELLS: GLOBAL MEDIA & COMM. WATCH (Jan. 21, 2016), http://www.hlmediacomms.com/2016/01/21/china-launches-first-operational-rules-for-civil-unmanned-aircraft/. *See also* Zhonghua Renmin Gongheguo Minyong Hangkong Fa (中华人民共和国民用航空法) [Civil Aviation Law of the People's Republic of China] (promulgated by the Standing Comm. Nat'l People's Cong., Oct. 30, 1995, effective March 1, 1996), NAT'L PEOPLE'S REPUBLIC OF CHINA LEGIS. AFF. COMMISSION, 1995, http://www.caac.gov.cn/en/ZCFG/MHFL/201509/P020150901511659239730.pdf.

50. Class V are agriculture and crop-related UAV, Class VI governs unmanned airships, and Class VII controls Class I and II UAV operated beyond visual line of sight outside 100m. For more information, please consult the chart for the CAAC classifications found in Jun Wei et al., *supra* note 49.

ideas that can be implemented by the FAA to ensure a more efficient method of monitoring ongoing UAV operations.

While the FAA does not require a constant real-time supervision system to watch over drones, the CAAC has decided to implement a "UAV Cloud"[51] and "electronic fence"[52] to several classes of drones. Drones under Class III, IV, VI, and VII[53] are required to have installed the electronic fence and be constantly connected to the Cloud when flying, and when operating in densely populated areas, operators are expected to provide reports every second. When operating in non-densely populated areas, reports are still expected frequently at every thirty seconds. Despite these somewhat Orwellian differences, however, the CAAC provisions have been styled to bring about similar protection to public safety as the FAA's Part 107 and Canadian drone regulation.[54] As such, the provisions also require the purchase of insurance for UAV covering liability for third parties on the surface, mandates that a certified, capable pilot be in command, and sets aside flight specifications for UAV operations in the visual line of sight (VLOS).[55] However, the strict requirement of having constant reports allows the CAAC to provide even more leeway in terms of drone operations, allowing for both operations beyond the visual line of sight (BVLOS) and nighttime flight for drones operating BVLOS.[56] The degree of laxness with which the CAAC has allowed domestic UAV operators freedom to operate has brought even more economic advantages to the Chinese commercial drone market, which we will see in the next section. This, in turn, allows for further innovation and advancements in China's CMI-backed UAV industry.

On the other hand, there is a dearth of regulations governing Chinese drones reaching the international market. The only "controlling" international agreement on UAVs seems to be the MTCR, of which only thirty-five countries are signatories. In 2004, China applied for membership, but was duly rejected because of its behavior of having loose export controls, especially with regards to missiles and armed drone sales to North Korea and Iran.[57] However, China has pledged itself as a voluntary adherent of the MTCR. With India's recent entry into the MTCR, the foundation has been laid to provide China with some insights into joining the MTCR, which will be discussed in the final section of the paper.

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51. A "UAS Cloud" is a dynamic database management system which monitors flight data (including location, altitude and speed) in real time and which has an alarm function for UAV flying into the electronic fence. *Id.*

52. The electronic fence is a software and hardware system in which specific areas are identified as prohibited and function to stop aircraft from entering such areas. *Id.*

53. *Id.*

54. HENRY H. PERRITT, JR. & ELIOT O. SPRAGUE, DOMESTICATING DRONES: THE TECHNOLOGY, LAW, AND ECONOMICS OF UNMANNED AIRCRAFT § 7.3.4 (2017).

55. Jun Wei, et al., *supra* note 46.

56. *Id.*

57. Wade Boese, *Missile Regime Puts off China*, ARMS CONTROL ASS'N (Nov. 1, 2004), https://www.armscontrol.org/act/2004_11/MTCR.

In mid-2015, China attempted self-regulation of export controls, with the Chinese State Administration of Science, Technology and Industry for National Defense (SASTIND) under the MIIT, joined by the Ministry of Commerce (MOFCOM), General Administration of Customs (Customs), and the army approving a temporary export ban on certain dual-use UAVs. These three systems include: (1) UAVs with a range of 300 km or greater; (2) UAVs with aerosol dispensing systems with apparatuses comprising a capacity of 20 L or more; and (3) UAVs having the operator's ability to control flight from outside the Line of Sight.[58] The export ban is still ongoing at the time of this writing. The export ban affects very few commercial UAVs, meaning that China's production and economy will be left largely untouched by the ramifications of this restriction.[59] With relatively lax domestic drone operations regulations and a handful of international drone export controls, China has been able to reap full economic advantage of the UAV industry.

II. TOO SOON TO TELL? RESULTS OF CHINA'S EXPANSION

Following the end of the Mao era, China underwent a rapid age of economic expansion and modernization, which continues today with its huge expansion into the UAV industry. As the U.N. Council on Foreign Relations reported in March 2015, the goal of contemporary China is "the accumulation of 'comprehensive national power,'" the pursuit of which involves all dimensions of economy, military, technology, and diplomacy.[60] One of the most crucial goals, however, is to sustain high economic growth, not only to maintain governmental legitimacy, but to maintain the international standing of modern China as well. To that end, the UAV industry, with its more flexible regulations on Chinese soil, has a powerful potential to act as a major agent of economic change and allow China to surpass the United States as the leader of the international UAV industry. There are both costs

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58. 商务部、海关总署、国家国防科技工业局、中国人民解放军总装备部联合公告2015年第20号（关于对军民两用无人驾驶航空飞行器实施临时出口管制的公告）[Joint Announcement [2015] No. 20 of the MOFCOM, Customs, SASTIND, and General Armament Department of the People's Liberation Army of China on Implementing Export Control over Dual-Use Unmanned Aircraft] (June 25, 2015), http://www.customs.gov.cn/publish/portal0/tab515/info761305.htm [https://perma.cc/3TPS-T486]. *See also* Laney Zhang, *Regulation of Drones: People's Republic of China*, LIBR. OF CONGRESS (Apr. 2016), https://www.loc.gov/law/help/regulation-of-drones/china.php.

59. Huifeng Hu, *China Restricts Exports of "High Performance" Drones as National Security Fears Heighten*, South China Morning Post (Aug. 1, 2015, updated Jan. 23, 2018), http://www.scmp.com/tech/china-tech/article/1845754/china-restricts-exports-high-performance-drones-national-security (according to Shao Jinhuo, vice-president of DJI Technology, which controls 70% of the global market for civilian drones, "[t]he ban is targeting drones not designed for commercial use, and will protect key technologies of Chinese companies.").

60. ROBERT D. BLACKWILL & ASHLEY J. TELLIS, REVISING U.S. GRAND STRATEGY TOWARD CHINA 8 (2015).

and benefits to reaching the top, as we will see through China's economic gain and potentially detrimental geopolitical consequences from this rapid expansion.

As part of China's move toward modern technological innovation, its government has backed trillions of yuan into the drone market.[61] Nevertheless, Beijing is not the only economic player in the Chinese UAV market. As discussed earlier, the embedding of foreign private companies into the Chinese UAV industry has greatly accelerated industry growth and acts as another crucial piece of the economic puzzle behind China's drones. In August 2015, Intel Corp., a U.S. investor, backed Chinese drone manufacturer Yuneec with $60 million, followed by an injection of $67 million in eight other Chinese drone companies that year. As a result of both government and privately backed foreign funding into the UAV industry, drones have reached beyond the military application of the Chinese economy and into a multitude of other sectors, encompassing agriculture,[62] oil and gas,[63] and municipal governance.[64]

The funding for and rapid developments in the Chinese UAV industry would have been highly unlikely had they occurred in a developed economy such as that of the United States. An overabundance of treaties and restrictive regulations placing strict prohibitions on the UAV industry, as well as cripplingly slow advancement in operations regulation has slowed the United States' presence in the UAV industry, greatly reducing its positive economic potential. On the other hand, the CAAC has released clear-cut but less restrictive regulations in 2016 covering the basic requirements and operational control of UAVs to ensure public safety (not unlike the FAA's Part 107), while also providing detailed guidelines for UAV classifications and the usage of UAV Cloud. As such, the CAAC's regulations have covered the public safety issue so promoted by the FAA, but have also addressed

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61. "China [has] spent a total of 1.42 trillion yuan ($206.05 billion) on R&D in 2015, up 8.9 percent over the previous year." Dominique Patton, *China's Spending on R&D Rises to 2.07 Percent of GDP*, REUTERS (Nov. 21, 2016), https://www.reuters.com/article/us-china-r-d-idUSKBN13G1NG. *See also* Xinhua, *Phones and Drones - China's Risk-Takers Who Rule the World*, CHINA DAILY, http://www.chinadaily.com.cn/china/2016-01/03/content_22910153.htm (last updated Jan. 3, 2016, 9:42 PM); Thibaud, *Drones Market in China Has Room to Soar*, DAXUE CONSULTING (June 29, 2016), http://daxueconsulting.com/drones-market-in-china-has-room-to-soar/.

62. Newley Purnell & Jack Nicas, *Chinese Drone Maker Plows into Agriculture*, WALL STREET J. (Nov. 26, 2015), http://www.wsj.com/articles/chinese-drone-maker-plows-into-agriculture-1448573490.

63. Hugh Harsono, *Drones: Putting China's Economy on Autopilot*, TECHCRUNCH (June 3, 2016), https://techcrunch.com/2016/06/03/drones-putting-chinas-economy-on-autopilot/.

64. *See* Jason Reagan, *Police Drones Unleashed in China*, DRONELIFE.COM (Jan. 28, 2016), http://dronelife.com/2016/01/28/police-drones-unleashed-in-china/; Xinhua, *SW China Police Use Drones to Monitor Traffic*, CHINA DAILY, http://www.chinadaily.com.cn/china/2016-09/18/content_26818926.htm (last updated Sept. 18, 2016, 3:39 PM).

potential R&D and production issues through a more detailed, but even more flexible guideline.[65]

As referenced earlier, several crucial economic actors have been alienated by the FAA's ever-tightening rules regarding commercial drone deliveries,[66] which are further hampered by the FAA's bureaucratic red-tape. In 2014, the FAA began issuing licensed exemptions for commercial drones on a case-by-case basis, but so far has only granted 6,100 waivers. There are still over 7,600 applications waiting for approval, with most of these companies either being unable to take flight at all, or risking the potential for high fines and penalties by operating commercial drones without the FAA's permission.[67] As such, many companies are turning away from the U.S. economy and looking for new testing locations elsewhere. Amazon, one of the largest international online retailers, has decided to look toward China as a primary source to develop a commercial delivery drone system.[68] Amazon's Prime Air service, aiming to deliver packages of up to five pounds to customers in under thirty minutes, has faced immeasurable difficulty in light of FAA regulations.[69]

Although Amazon recently has expanded its drone delivery testing sites to include the United Kingdom,[70] it continues its negotiations with Beijing to achieve drone delivery in China's fast-paced UAV industry. This not only advances China's technological innovation, but greatly expands China's economic output

65. For example, current FAA regulations have limited the usage of commercial drones to only a select few industries, such as surveying in the agriculture, mining, and oil and gas sectors. On the other hand, the CAAC's classification of UAV is mainly based on weight (with Class V being the exception of agricultural UAV), but no other restrictions are announced. As long as research, production, and operation of new UAV conform to the policies per class, and are connected to the UAV Cloud, Beijing sees no reason to create so many barriers to entry and operation to the UAV industry, unlike the FAA.

66. Under these rules, commercial drones weighing up to 55 pounds may fly only during daylight hours, reducing Amazon and other retailers' ability to run drone deliveries only a handful of hours a day (even less in winter months). FAA requires pilots to retain constant VLOS and fly under 400 feet to avoid airplanes. Operations must also avoid flying over people in public so as to preserve public safety. Pilots must pass a safety test every 24 months and be vetted by the TSA before the FAA can clear them for these commercial drone operations.

67. Associated Press, *White House Clears Small, Commercial Drones for Takeoff*, ABC 10 NEWS (June 21, 2016, 7:48 AM), http://www.10news.com/news/national/white-house-clears-small-commercial-drones-for-takeoff.

68. *See* PERRITT, JR. & SPRAGUE, *supra* note 54 ("The relative maturity of Chinese drone regulation has permitted Amazon and local competitors to experiment with drone package delivery more extensively in China than elsewhere.").

69. The FAA requirement that pilots retain a constant VLOS for all instances when operating a commercial drone creates a massive obstacle for commercial drone deliveries.

70. On July 25, 2016, Amazon announced its partnership with the British government to test commercial drone delivery. *See* Ananya Bhattacharya, *Up Up and Away: Amazon is Going to Britain for Drone Testing U.S. Won't Allow*, QUARTZ (July 26, 2016), http://qz.com/742396/amazon-is-going-to-britain-for-drone-testing-the-us-wont-allow/.

from drones as well. Due to China's more accommodating views and regulations[71] on drone deliveries and commercial operations, Amazon's Prime Air service, as well as the proposed Google Project Wing,[72] already face competition in such a nascent sector. Within the last two years, two e-commerce giants operating out of China (JD.com and Alibaba) began operating commercial drones in parts of China for delivery purposes. In 2015, Alibaba partnered with Shanghai YTO Express Logistics Corp. to deliver tea packets to over 450 Chinese customers who volunteered for a trial of drone delivery. Although this was a one-time program, Chinese UAV regulations were accommodating enough to allow Alibaba to test its drones over densely populated cities including Guangzhou, Shanghai, and Beijing.[73] This project was successfully replicated by Alibaba's largest rival in e-commerce, JD.com.[74]

Despite the presence of these companies, Amazon and Google remain heavily invested in the prospects of expanding their drone delivery services to China. The appeal lies in China's less stringent regulations of the UAV industry, with both the government and private industry working in concert to promote and advance the development of military and commercial UAVs. China stands to expect an economic windfall from its loose regulations with regards to commercial drone delivery operations, especially with so many domestic and foreign corporations interested in operating in the country in the face of already well-established domestic competitors.

Outside of benefitting from less restrictive commercial drone operations regulations, China has also managed to corner a crucial segment of the international UAV market—low-cost drones.[75] Because it is not a member of many of the treaties and ratifications that have attempted to limit the proliferation of dual-use UAVs, China is easily leaping into a sparsely contested international UAV

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71. "Outside the U.S., many countries have adopted simple rules allowing commercial use of drones, then adjusted the rules based on experience." *See* L. Gordon Crovitz, *While Amazon Waits, Drones Fly*, WALL STREET J. (June 26, 2016, 5:20 PM), http://www.wsj.com/articles/while-amazon-waits-drones-fly-1466976049.

72. Another commercial drone delivery operation, this time founded by Google but still continuing in talks with China to expand testing to the Chinese market.

73. *See* Lulu Yilun Chen, *Alibaba Drones Fly Over Beijing While Amazon Pleads for U.S. Tests*, BLOOMBERG TECH. (Feb. 4, 2015, 1:59 AM), https://www.bloomberg.com/news/articles/2015-02-04/alibaba-drones-fly-over-beijing-as-amazon-pleads-for-u-s-tests.

74. In east China's Jiangsu Province, JD.com has been operating two drones, carrying up to 33 pounds of cargo, over a distance of 12 miles, and up to 33 miles per hour, according to JD.com's VP. Additionally, these UAVs can fulfill up to 200 orders a day and have dropped the delivery cost to less than a dime per order. *See* Felipe Araujo, *Chinese Company Beats Amazon to Deliver Online Goods by Unmanned Drone*, MIRROR.CO.UK (June 19, 2016, 3:55 PM), http://www.mirror.co.uk/news/world-news/chinese-company-beats-amazon-deliver-8230920; *see also* Kelsey D. Atherton, *Chinese Company Begins Offering Drone Deliveries to Rural Areas*, POPULAR SCI. (June 8, 2016), http://www.popsci.com/chines-online-retailer-start-drone-delivery-in-rural-areas.

75. *See* Krasner, *supra* note 4, at 26.

market.[76] While the United States continues its strict adherence to the MTCR and has only recently come to realize the economic benefits of international weaponized drone sales, China has for the past few years already established a strong foothold in the international drone market. The main reason for this dominance is China's ability to beat out the United States in pricing. Although studies have found that the Chinese UAV R&D has not yet caught up with that of the United States,[77] smaller, developing nations with less spending money are more than willing to pay for an inferior product at a bargain price.[78] In late 2015, Iraqi forces allegedly used Chinese-made Cai Hong CH-4s to destroy ISIS positions in Ramadi.[79] In 2016, Nigeria confirmed that it purchased five Chinese-made CH-3s to combat the militant group Boko Haram.[80] Other nations that have purportedly purchased weaponized UAVs from China include Pakistan, Saudi Arabia, Egypt, and the United Arab Emirates.

As China continues its path to leading the UAV industry, it will most likely have to become a member of the MTCR. This is highly valuable to China's UAV industry, as it would be allowed to trade and transfer sensitive UAV technology with other member MTCR nations, and sell UAV systems to any nation without any sanctions. [81] However, these recent unregulated sales of weaponized UAVs might jeopardize China's chances at being allowed into the MTCR, as nations feel it continues the trend of China's sales record to rogue nations such as North Korea, Iran, and Pakistan.[82] In spite of this, China's recent export control policies have shown it is willing to make the necessary changes required to be a member of the

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76. *See* Sarah Kreps, *China Swooping in on Military Drone Market*, CNN (Apr. 1, 2016, 12:33 PM), http://www.cnn.com/2016/04/01/opinions/china-drone-sales-kreps/.

77. Out of the seven models listed by the International Institute for Strategic Studies' Military Balance 2011 as in active PLA service, about half are outdated and limited in capability. Two models in service, the ASN-105 and ASN-206, are based on technology from the 1960s. The CH-1 Chang Hong was based on 1950s U.S. technology. Other UAVs are developed in the 1960s (and thus beyond antiquated) or purchased from old Israeli technology. *See* Houpt, *supra* note 5.

78. For example, the Wing Loong drones made by AVIC cost $1 million, compared to its counterpart with similar technology, the $30 million U.S. Reaper. *See* Sieren, *supra* note 24.

79. *See* Patrick Boehler & Gerry Doyle, *Use by Iraqi Military May be a Boon for China-Made Drones*, N.Y. TIMES (Dec. 17, 2015), http://www.nytimes.com/2015/12/18/business/international/china-drone-export-iraq.html?_r=1.

80. *See* Kelsey D. Atherton, *Watch Nigeria's First Confirmed Drone Strike -- Against Boko Haram*, POPULAR SCI. (Feb. 3, 2016), http://www.popsci.com/watch-nigerias-first-confirmed-drone-strike.

81. *See* Vivek Raghuvanshi, *New Diplomatic Status Fuels Indian Appetite for Arms Trade*, DEF. NEWS (June 16, 2016), http://www.defensenews.com/story/defense/2016/06/16/new-diplomatic-status-fuels-indian-appetite-arms/85979808/.

82. *See* Prakash Katoch, *China's Great Betrayal: Why did India's Eastern Neighbour Block the NSG Bid?*, FIRSTPOST.COM (June 24, 2016, 3:10 PM), http://www.firstpost.com/world/chinas-great-betrayal-why-did-indias-eastern-neighbour-block-the-nsg-bid-2853800.html.

MTCR. With the realization that it has become a primary exporter of UAVs to the international market, China has taken some steps toward limiting the rampant proliferation of drones, specifically weaponized UAVs. As discussed above, the 2015 export ban was a first step toward China attempting to limit the proliferation of its armed UAV exports, realizing its critical role as a leader in the international drone revolution. This opens the door for a multitude of collaborative opportunities between the United States and China, as the current leaders of the UAV industry, to boost their economies through the UAV industry.

III. TOWARD A BRIGHTER FUTURE

As the two leading entities in UAV development, production, export, and regulation, China and the United States are in the best positions to spearhead the creation of an efficient international framework for exports of weaponized drones and an effective synthesis of both FAA and CAAC regulations to promote economic innovation in the commercial drone sector. The FAA and CAAC have had a long-standing history of joint bilateral work and cooperation going as far back as the early 1980s.[83] Today, both agencies have already issued relatively similar regulations governing UAVs, setting up "a risk-based approach framework that regulates UAS in a manner proportionate to the risk presented by the UAS operation."[84] The FAA's regulations have already received harsh criticism a few months into their implementation, since they are found to be extremely restrictive on commercial drone operations. Exemptions are generally approved, but are backlogged in a line over 7,000 applicants long. As these regulations are constantly evolving and subject to change,[85] it could stand to draw some changes and ideas from the CAAC regulations. Certainly, the United States would have to adopt a similar mindset as the Chinese government toward commercial operations of drones. The FAA constantly stresses the importance of public safety in issuing regulations on UAVs, placing similar emphasis on operations over densely populated urban areas as it does on operations in rural, non-densely populated areas. However, this severely restricts drone flights to only daylight operations within the VLOS, which have hampered the efforts of companies implementing drones in their deliveries. Instead, the FAA should loosen standards to allow less-restrictive flights over rural, non-densely populated areas, similar to the CAAC

83. The most prominent of which were the establishment of the US-China Civil Aviation Agreement and the Bilateral Airworthiness Agreement in 1984. *See* THERESA L. KRAUS, CELEBRATING A HISTORY OF EXCELLENCE: FEDERAL AVIATION ADMINISTRATION/CIVIL AVIATION ADMINISTRATION OF CHINA EXECUTIVE LEVEL COOPERATION AND THE AGREEMENT PROCESS 2 (2010), https://www.faa.gov/about/history/media/celebrating-faa-caac.pdf.

84. *See What Can the FAA Learn from China?*, DRONE360 MAG. at 14 (March/April 2016) (quoting Lisa Ellman, partner of Hogan Lovells and co-chair of their UAS Group).

85. *See* 14 C.F.R. § 107 (2016).

only requiring thirty-second updates instead of the constant updates every second for operations over densely populated urban areas.

The FAA and the U.S. government should also take note of China's UAV Cloud and electric fence system, which links all connected and registered UAVs into a cloud monitored by the government. While this may seem to be governmental overreach, China's electronic surveillance system only requires certain UAV classifications to be connected to the network when they are operating in key governmental areas or in airport clear zones. Heavier commercial drones and unmanned airships are required to be constantly connected and registered to the electronic network,[86] an understandable precaution required to protect the public safety and prevent any accidents.[87] Not only is this system more reliable than geo-mapping capabilities on individual drones, but it is also an efficient failsafe, allowing the government to shut down any connected UAV that poses a threat or whose pilot has lost control of the system. The constant updates to China's cloud system by connected UAVs also, while restrictive, is a terrific consideration for expanding to cover UAV regulations in the United States. This instills accountability and responsibility to each pilot, since his actions are constantly tracked and accounted for by the cloud network. Additionally, the FAA could, by receiving constant updates regarding the tendencies of UAV pilots or patterns of UAV operations, adapt its regulations to meet fluctuating demands of a constantly evolving new sector.

Turning to the international export controls, the United States and China are well suited to work together toward a standardized international framework for weaponized UAV exports. The United States stands in a dominant position to convince China to help formulate such an agreement. Given that the United States is the most prolific user of armed drones in the world,[88] and with the investment of numerous Western corporations into China's burgeoning UAV industry, the United States has enough clout within the UAV industry and China to bring this issue to the table. China had already attempted to join the MTCR in 2004 and, despite being rejected, remains a selective adherent. With its most recent export ban on dual use

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86. *See* Jun Wei et al., *supra* note 49.

87. At time of publication, the CAAC has introduced a "real-name registration" regulation, requiring all civil UAV manufacturers and owners to apply for an account in the CAAC UAV Real-name Registration System starting June 1, 2017. CAAC, *Regulations on Real-name Registration of Civil Unmanned Aerial Vehicles Formally Issued by CAAC*, CIVIL AVIATION ADMINISTRATION OF CHINA (May 24, 2017), http://www.caac.gov.cn/en/XWZX/201705/t20170524_44222.html. This was allegedly due to drone disruption of over 240 airline flights near the Chongqing Jiangbei International Airport in April of 2017. Li Tao, *DJI Sales Hit by Tighter Chinese Government Regulations on Drone Flight Safety*, SOUTH CHINA MORNING POST (May 24, 2017, 9:19 PM), http://www.scmp.com/business/companies/article/2095562/dji-sales-hit-tighter-chinese-government-regulations-drone-flight.

88. *See* MICAH ZENKO & SARAH KREPS, LIMITING ARMED DRONE PROLIFERATION 6 (2014).

UAVs, China has shown itself to be a potentially willing participant in some form of regulatory framework limiting the exports of weaponized unmanned systems.

India's recent entry into the MTCR is a double-edged sword, providing insights toward, while acting as an obstacle against, China's potential future within the MTCR's framework. As a new signatory, India is expected to place voluntary restrictions on its own exports and end-use agreements on trades of armed UAVs. In return, India will most likely see an increase in trades with other MTCR members through transfers of sensitive technology, including armed UAVs. Additionally, it will enhance the joint ventures between India and other nations[89] and allow India to sell and transfer its UAVs and missile systems to non-MTCR countries without attracting sanctions. Given its position as one of the world leaders in the UAV industry, China stands to gain quite a bit from its entry into the MTCR. The ability to freely transfer sensitive UAV technology between MTCR members will certainly boost China's own UAV research, and serve to build a more solid Sino-U.S. relationship. On the other hand, India now has veto power over entry of aspiring states, and has "a leverage against China, which can be wielded in the same way as China has used its membership in NSG to prevent India's entry."[90] However, given the economic benefits of membership and realization of its leading role in the UAV industry, China will most likely cooperate with the requirements for MTCR members to be part of this agreement. If it does, China will be able to collaborate with the other members and, more importantly, with the United States to affect more encompassing and efficient changes to the MTCR.

Recognizing the limitations of the MTCR, several studies have attempted to suggest a different framework by which an international regulation of UAVs can attain worldwide acceptance.[91] One of the most convincing arguments is found in the UNCFR Report No. 69, where the authors find that "the domestic politics of treaty ratification and the international politics of removing drones from the MTCR and creating a new treaty would only create more barriers to an international agreement on the governance of [UAVs]."[92] What is important is that the MTCR undergo a process of clarification, where countries interested in creating an international governance on UAV exports would have to establish "an accepted

89. With its entry into the MTCR, India is set to discuss a joint venture with Russia to develop the Brahmos cruise missile system to sell to third countries. *See* Ankita Rajeshwari, *What is MTCR and How can India Benefit From It?*, TIMES OF INDIA (June 7, 2016), http://timesofindia.indiatimes.com/What-is-MTCR-and-how-can-India-benefit-from-it/listshow/52640322.cms.

90. *See* Raghuvanshi, *supra* note 81.

91. *See, e.g.*, *id.*; JOHN P. ABIZAID & ROSA BROOKS, RECOMMENDATIONS AND REPORT OF THE TASK FORCE ON U.S. DRONE POLICY 47–48 (2d ed. 2015) (discussing additional factors to add to the MTCR, such as establishment of special factors to overcome "presumption of denial," and recommending the U.S. government to re-evaluate and identify the two categories covered by the MTCR.).

92. ZENKO & KREPS, *supra* note 88, at 23.

understanding of how specific legal terms are interpreted and applied . . . [and a] more faithful and transparent adherence to them."[93] This includes a restructuring of the "strong presumption of denial" clause, which merely suggests that members should strongly presume denying the export of Category I UAVs. Unfortunately the United States, even as the co-founder of the agreement, has managed to find exemptions to this clause, exporting Category I UAVs to close allies, arguing that proliferation norms will erode once countries have the capabilities to produce Category I items domestically and start exporting them.[94] With China as a member of the MTCR, a Sino-U.S. cooperation could start promoting a more stringent standard of proliferation of Category I systems, beginning with reflection and potential synthesis of the United States' and China's most recent attempts at self-regulation of weaponized UAVs.

Additionally, the MTCR would have to be altered to address the modern advancements in UAV technologies. The definitions laid out by the MTCR, specifically that of Category I systems, are based on arbitrary payloads and thresholds and only show how any advances in the UAV industry could export a Category I armed drone in the future (by making it lighter or fall just short of threshold requirements). Instead, there should be a shift toward "an agreement organized around . . . mission type—lethal versus nonlethal" that would be more relevant with the rise of technology.[95] Considering several nations' (including China) objections to the export of armed drones,[96] it seems many are open to dialogue for an international agreement governing exports of armed UAVs.

One available course of action would be to hold formal Sino-U.S. discussions to increase the transparency and predictability as to U.S. and Chinese drone exports through the U.S.-China Strategic and Economic Dialogue Process. This process has strong potential to place both leading nations of the UAV industry in the same room to begin talk processes regarding bringing China into the fold of the MTCR and updating the MTCR to reflect the modern UAV realities. With ever-increasing numbers of U.S. companies investing into the Chinese drone market,[97] and with the Chinese market containing five of the top eleven venture capital-funded drone

93. *Id.*

94. *Id.* at 18.

95. *Id.*

96. China had pointed to armed drones in the international arena as "[a] 'blank space in international law' that is 'subject to abuse.'" *Id.* at 20.

97. As discussed above, Intel Corp.'s backing of Yuneec and eight other Chinese drone companies. In March of 2016, Qualcomm Inc. set up a $2.8 million joint venture with China's Thunder Software to develop drone software. *See* Eva Dou, *Qualcomm Will Make China-Customized Chips Through Chinese Venture*, WALL STREET J. (May 27, 2016, 8:13 AM), http://www.wsj.com/articles/qualcomm-will-make-china-customized-chips-through-chinese-venture-1464351198.

companies globally,[98] it would be in the interests of both nations to come together to regulate the international UAV market and reap its full economic advantages.

The only setback to U.S.-Chinese cooperation would be each nation's individual domestic politics, especially the U.S. Congress. Amongst senior U.S. government officials, there is a staunch, unresolved divide over the U.S. exports of UAVs, especially those with dual-use military capabilities. On one hand, there are officials who believe that leasing or selling dual-use, or even armed, UAVs to friendly nations would foster better partnership capacity amongst U.S. allies and partners.[99] On the other hand are officials that believe that any alteration of the MTCR to loosen international export controls on UAVs would "erode the norm created by other MTCR member states, as well as non-members."[100]

The impression of China's view of the UAV industry and fostering international cooperation with regards to export and proliferation seems to be quite positive. Unfortunately, there has been little conversation coming from China's end about promoting a joint U.S.-China endeavor to alter the MTCR and bring about international governance for UAV exports. Perhaps this was because of the 2004 MTCR membership snub, or perhaps Beijing may be simply focused on addressing domestic regulations and taking advantage of the international drone market before limiting China by entering into international export agreements. In any case, China's 2015 export ban on dual use UAVs, and its voluntary adherence to the MTCR (ironic, in light of its recent sales of armed drones to other nations), are pointed in the right direction, and hopefully a sign of more to come. Only then will we be taking the proper steps toward ensuring more efficient UAV operational standards and advancing toward better standardized regulations for international production and export of UAVs.

Despite these obstacles, the regulatory efforts of the CAAC and FAA have established a foundational blueprint that acts as a jumping-off point for several other national UAV regulations. In the developing ACP countries, the UAV market has rapidly expanded into the natural resource management sector, such as the management of crops, livestock, fisheries, and forests.[101] As such, these nations have developed similar regulations to that of the CAAC and FAA, placing limitations and restrictions on aircraft registration, no-fly zones, operator certification, and aircraft restrictions by weight category. Although not a staggering

98. Kay Wackwitz, *These are the Top20 VC-Funded Drone Companies to Have on Your Radar in 2016*, DRONE INDUS. INSIGHTS (Jan. 25, 2016), https://www.droneii.com/top20-vc-funded-drone-companies-2016.

99. Furthermore, these officials believe that this would also allow the U.S. to "promote [the UASs] responsible use with monitoring and end-user verification agreements." ZENKO & KREPS, *supra* note 88, at 18.

100. *Id.* at 19.

101. *Drone Governance: A Scan of Policies, Laws and Regulations Governing the Use of Unmanned Aerial Vehicles (UAVs) in 79 ACP Countries* 1 (Tech. Ctr. for Agric. & Rural Cooperation, Working Paper 16/12, 2016), https://publications.cta.int/media/publications/downloads/1971_PDF.pdf.

number by any means, 19 percent of the ACP countries (fifteen of the seventy-nine member nations) have already established rules specific to UAV operations, and six other ACP countries have announced soon-to-be-drafted UAV legislation.[102] A main driving force for UAV regulation in the ACP countries has been the International Civil Aviation Organization (ICAO), an extension of the United Nations. The ICAO has published guidance manuals[103] assisting regulators in addressing issues arising from UAV expansion and has called on states to defer to their guidance on establishing UAV regulations, many of which parallel the CAAC and FAA regulations.[104]

In Japan, the increasing use of UAVs for rescue operations, natural disaster relief, and commercial purposes has led the government to adopt similar UAV regulations as those promulgated by the CAAC. Like China, Japan is attempting to introduce BVLOS flights, a policy that the FAA regulations have lagged on. This would allow pilots to operate drones beyond their own visual line of sight, opening up the potential for boundless commercial and natural disaster relief applications for UAVs. As such, many companies are flocking to Japan, as well as China, to test these new commercial drone applications.[105] While China has allowed a few small commercial UAV trials in densely populated areas, Japan has formed special de-regulation zones to test the feasibility of commercial drones. In one of such zones, Chiba (a city about twenty-four miles east of Tokyo), the Japanese government has loosened regulations on maximum flight altitude and line of sight requirements to accommodate commercial drone delivery trials. Working closely with research institutes, private companies, and city officials, the Japanese government has actively encouraged[106] the drone delivery of prescription medicines and daily necessities in Chiba and has shown that it is entirely possible to continue developing UAV regulations while promoting innovative UAV applications and usage.

The European Union has faced a fragmented regulatory framework when it came to UAV regulations. Given the nature of the European Union itself, a large

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102. Of the ACP countries with existing UAV regulations, seven of the Caribbean countries established their UAV policies without updating their Civil Aviation Regulations (CARs), showing that drone regulation can be put in place rapidly. *Id.* at 9.

103. *See* Int'l Civil Aviation Org. [ICAO], *Unmanned Aircraft Systems (UAS)*, Cir 328 AN/190 (2011), https://www.icao.int/meetings/uas/documents/circular%20328_en.pdf.

104. *See* Int'l Civil Aviation Org. [ICAO], *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Doc. 10019 AN/507 (1st ed. 2015), http://servicos.decea.gov.br/arquivos/drone/Doc_10019_Manual_on_RPAS__English_.pdf.

105. *See* Miriam McNabb, *Japan Adjusts Drone Regulations to Support Industry*, DRONELIFE.COM (Jan. 4, 2016), http://dronelife.com/2016/01/04/japan-adjusts-drone-regulations-to-support-industry/.

106. *See* Miriam McNabb, *Japan Designates "Deregulation Zones" to Test Drones*, DRONELIFE.COM (Dec. 16, 2015), http://dronelife.com/2015/12/16/japan-designates-deregulation-zones-to-test-drones/. *See also Chiba Drone Alliance Pushes for Delivery Service by 2019*, THE JAPAN TIMES (Oct. 7, 2016), http://www.japantimes.co.jp/news/2016/10/07/business/chiba-drone-alliance-pushes-delivery-service-2019/#.WIYaWLYrKnc.

majority of the UAV legislation differed from member state to member state, with each nation experimenting and developing its own specific sets of regulations. Recognizing the need to match the rapid pace of UAV development with a standardization of industry standards and activities,[107] the European Aviation Safety Agency (EASA) issued a basic regulatory guidance manual to address a key number of UAV operational safeguards in a coherent manner.[108] In August 2016, the EASA published "The Prototype," which sets outs a regulatory framework for UAVs that is operation centric, proportionate, and risk-and-performance-based, not unlike those established by the FAA and CAAC.[109] The "Prototype" also provides general limitations on hobby drones, operator certification, VLOS, and no-fly zones.[110] As a relatively new body of legislation, only time will tell if the EASA's "Prototype" is successful at UAV regulation. Given the relative success of the CAAC and FAA policies, it is not implausible for the new EASA regulations to bring tremendous positive impact in the European drone industry.

CONCLUSION

The future of the UAV industry has just begun, and is slated to see a dramatic surge over the next few decades. As technology develops, more and more nations will acquire UAVs at a lower price, resulting in rampant international UAV proliferation. As leaders in the industry, China and the United States are the best candidates to reach out to the international community to establish an efficient, synthesized commercial drone operations regulatory policy, and restructure the international regime regarding armed UAV exports. Despite both nations being in the forefront of the modern UAV industry, they are not without their own faults and drawbacks.

The "drone revolution" took hold in the United States in the early 1970s, mainly as part of military initiatives. However, in the last few years, the production and operation of civilian and commercial UAVs have become extremely prevalent thanks to the military-industrial complex branching out into the commercial civilian UAV sector. As a response to this massive surge, the FAA has been by far the most effective regulatory body governing the domestic operation of UAVs, attempting to create a series of flexible regulations that can adapt to the ever-changing future of the UAV industry. However, the FAA regulations have been

107. *See* EUROPEAN AVIATION SAFETY AGENCY, 'PROTOTYPE' COMMISSION REGULATION ON UNMANNED AIRCRAFT OPERATIONS 4 (2016) (explanatory note to prototype regulation), https://www.easa.europa.eu/system/files/dfu/Explanatory%20Note%20for%20the%20UAS%20Prototype%20regulation%20final.pdf.

108. *Civil Drones (Unmanned Aircraft)*, EUROPEAN AVIATION SAFETY AGENCY, https://www.easa.europa.eu/easa-and-you/civil-drones-rpas (last visited Dec. 12, 2017).

109. *See* EUROPEAN AVIATION SAFETY AGENCY, 'PROTOTYPE' COMMISSION REGULATION ON UNMANNED AIRCRAFT OPERATIONS (2016) (prototype regulation), https://www.easa.europa.eu/system/files/dfu/UAS%20Prototype%20Regulation%20final.pdf.

110. *Id.*

created at a glacial pace, raising questions of whether or not they will be effective in keeping up with the pace of UAV modernization. Additionally, FAA regulations place stringent restrictions on operations of commercial UAVs, leading to vocal backlash and potentially undermining the economic benefits the United States had to gain from the UAV industry.

China has also undergone a similar "drone revolution," seeing massive spikes in its UAV R&D, production, export, and regulations. These operational regulations, which retain certain similarities to FAA policies, are a lot more flexible and accommodating to commercial drone operations than Part 107. Coupled with the Chinese government's open and direct involvement in the UAV industry, and the complex, interwoven nature of foreign private industry, SOEs, academia, and the PLA, China stands to undergo a massive UAV modernization and see huge economic returns in the coming years. However, the state-funded nature of a majority of China's UAV industry comes at a cost, resulting in complaints of biased selection and corruption.[111] Despite these setbacks, China's UAV industry is continually expanding, threatening to outpace the United States in the coming few years.

China is slowly but surely beginning to understand the importance of its role in setting the future agenda of the UAV industry, both domestically and internationally. Like the United States, China carries the responsibility of ensuring that its UAV production, export controls, and operational regulations are well-classified and are easily clarified. As such, China should consider re-application to the MTCR, and signatory members should heavily consider allowing China into the agreement. This will allow China and the United States, two leading nations in the UAV industry, to take charge of making the necessary alterations to the MTCR so as to ensure the bright future of the rapidly rising UAV market. In the realm of domestic commercial drone regulations, both the CAAC and FAA are the leading established authorities, having created regulatory frameworks upon which other nations legislate their commercial UAV regulations. With more and more nations adopting similar measures, it will not be long before the leading aviation authorities initiate a concerted effort to form an international framework to regulate commercial UAVs.

111. Similarly, with regards to operations of UAVs, civilians have noted that "penalties for violations of the law in China typically are more severe than in other states, although enforcement is uneven and often politically motivated." PERRITT, JR. & SPRAGUE, *supra* note 54.