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BUILDING DEVELOPING AIR FORCES AROUND REMOTELY PILOTED AIRCRAFT

by

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DISCLAIMER

Biography

Lieutenant Colonel Ryan Weisiger is a U.S. Air Force combat systems operator assigned to the Air War College, Air University, Maxwell AFB, AL. He graduated from the Virginia Military Institute in 1998 with a Bachelor of Science degree in Mechanical Engineering, and Air University in 2010 with a Masters in Military Operational Arts and Science. He earned his wings in 2000 and has over 2,200 flying hours in the B-1 and has Remotely Piloted Aircraft experience. He has served on the staff at USAFCENT and ACC, and is a graduated squadron commander.

Abstract

With the price of aircraft continuing to increase as more capable technology is added onto platforms, the cost to develop an air force is continually on the rise. A cost-effective way to build an air force is through Remotely Piloted Aircraft (RPA). These platforms offer a diverse set of capabilities at significantly reduced cost, and their capabilities will continue to expand over time. The purpose of this research paper is to show that developing countries, with limited budgets, can build an air force around RPAs instead of more expensive alternatives. Africa is the test case for this paper because of its unique security situation. Most African countries focus on internal security threats instead of external threats. Internal and non-state actor security issues such as terrorism, drug trafficking, piracy, organized criminal activities, and migration plague Africa's ungoverned spaces. RPA distinguishing characteristics make them well suited for critical infrastructure protection, counter-piracy, counter-drug, disaster relief, humanitarian aid, search and rescue, and counter-terrorism missions. All these missions apply directly to the irregular threats from non-state actors in Africa today. When comparing RPAs to manned aircraft there is a significant savings over the lifetime of the aircraft from initial procurement, sustainment, and training. The two main obstacles to developing nations wanting to build an air force around RPAs are strict export policies and regulations, and the integration of RPAs into the national airspace. Recommended changes to the Missile Technology Control Regime can open up the US defense industry to export RPAs, and General Atomics Aeronautical Systems has targeted 2020 to produce a MQ-9 variant able to fly unrestricted in national airspace. With these two changes implemented, the conditions for developing countries to build an air force around RPA capabilities will be set.

Introduction

With the price of aircraft continuing to increase as more capable technology is added onto platforms, the cost to develop an air force is continually on the rise. Today an F-35 cost about $89M, an F-22 $143M, an F-15E $31M, and an F-16 $19M. The ability to acquire sufficient quantities of low-cost, capable aircraft to build an air force is difficult. A cost-effective way to build an air force is through Remotely Piloted Aircraft (RPA). These platforms offer a diverse set of capabilities that can meet a large percentage of air force mission requirements at significantly reduced cost, and their capabilities will continue to expand over time.

The analysis in this paper will focus on RPAs, a subset of Unmanned Aircraft Systems (UAS). Other subsets of UASs are Small Unmanned Aircraft Systems (SUAS), drones, or Unmanned Aerial Vehicles (UAV). All of these are "an aircraft operated without the possibility or direct human intervention from within or on the aircraft."[1] However, the distinction between subsets is based on the capability of the platform and the pilot. For this paper, the United States Air Force RPA Vector is used as a guide for classifying the subsets. An RPAs requires a rated pilot, sensor operator or system operator, a ground control station (GCS) and communication infrastructure to perform mission and intelligence integration.[2] SUASs do not require a rated pilot, can be operated remotely or on pre-programmed autonomous routes, and can be expendable or recoverable.[3] Additionally, SUAS operate at slower airspeeds, under 4,000 ft, and without a GCS.[4] Without a GCS, it does not have the ability to communicate with controlling agencies. Examples of US SUASs are the Scan Eagle and the Raven. Drones are not included in the USAF RPA Vector, but are considered small commercially purchased aircraft that do not require any operator training, remain below 500 feet, and typically remain in line of sight and visual range of the operator. Quadcopters are an example of a drone. With advances in artificial intelligence, research has been conducted in the utility of autonomous drone swarms. All categories of UASs can contribute and should be integrated into the mission requirements of an air force. However, RPAs due to their size, operating envelope, time on station, ground control station, and communication capabilities provide a larger spectrum of capabilities. RPAs also offer a much easier path to integration into the un-segregated national airspace where civilian aircraft operate. All of these factors are critical components in order to build an air force around RPAs. For this reason, the analysis concentrates on RPA capabilities. SUASs and drones should play a complementary role.

The purpose of this research paper is to show that developing countries, with limited budgets, can build an air force around RPAs instead of more expensive alternatives. Africa is the test case for this paper because of its unique security situation. Most African countries focus on internal security threats instead of external threats, or projecting power outside their borders. Internal security missions are particularly well suited for RPAs. First, the paper will provide analysis of the African security threats. Once the security threat is defined, the paper will identify current and future RPA capabilities able to address these threats and highlight RPA limitations. Next, a comparison of traditional life cycle cost for manned aircraft against the life cycle cost of RPAs will illustrate the significant cost savings of RPAs. Finally, the paper will focus on two areas of regulations and policies which must be tackled in order to allow developing air forces to build around RPAs: 1) US export policies and regulations, and 2) integration of RPAs into un-segregated national airspace.

African Security Threats

African security challenges have changed significantly over history, and these were mostly influenced by external factors. Africa was highly influenced by Europe for over 400 years before the colonial period started with the Berlin Conference in 1884.[5] The Berlin Conference separated Africa into regions of European colonial control. This period was marred by foreign control with infrastructure geared toward the removal of natural resources for Europe's consumption. This period ended after World War II, with an international focus on national sovereignty and away from colonialism. Arbitrary borders were drawn without ethnic considerations. The Cold War period resulted in a significant arms race. Military capabilities and budgets expanded as countries aligned with either the US or the Soviet Union and received aid.[6] However, after the Cold War, Africa was forgotten by most of the international community until after the September 11th attacks put counter terror operations on the global stage.

The Organization of African Unity (OAU) was created in 1963 in the ideology of pan-Africanism, and its charter was built on the fundamental premise of 'respect for the sovereignty and territorial integrity of each state.'[7] While the OAU did not achieve much from a humanitarian perspective because of its emphasis on non-interference in sovereign affairs, a significant feat was the rare occurrence of state on state wars.[8] On an instable continent, few wars since the OAU was established have been traditional inter-state wars, and only in the invasion of Uganda by Tanzania did one state lead to the overthrow of the regime in another.[9] In 2002, the OAU transformed into the African Union and took on more of a humanitarian and internal security role. The main difference was the departure from non-interference to establishing the right of the Union to intervene in domestic affairs of member states in cases of 'war crimes, genocide and crimes against humanity' and to 'defend the sovereignty, territorial integrity and independence of its Member States.'[10]

The history of Africa has shaped today's security environment where countries do not have an existential external threat, but face internal irregular threats from non-state actors. For example, the most significant threat to Nigeria's national security is violent extremism by the Boko Haram group, also referred to as the Islamic State of West Africa (ISWA).[11] In northern Africa, there is competition and tensions between Algeria, Libya, Morocco, and Tunisia, but no state is actively preparing for war with a neighbor.[12] Terrorism remains the main security challenge in North Africa.[13] While security threats in the rest of Africa vary somewhat by region, the following internal and non-state actor security issues are well documented: terrorism, drug trafficking, piracy, oil bunkering, organized criminal activities, and environmental crimes such as poaching and deforestation.[14,15,16,17] In interviews with a senior officer from the Royal Moroccan Air Force and one from the Uganda Air Force, both agreed that internal security threats were their nation's air force primary concern.[18,19] While beyond the ability of an air force to have a direct impact, unemployment, corruption, and weak governance also plagues Africa. These are interlinked to Africa's irregular threats. Dr. Andre Le Sage, a Senior Research Fellow at the Institute for National Strategic Studies explains, "They create a vicious circle where irregular threat dynamics sustain black markets directly linked to state corruption, divert attention from democratization efforts, generate or fuel civil wars, drive state collapse, and create safe havens that allow terrorists and more criminals to operate." Dr. Sage contends, "Since the end of colonialism, the most competent of Africa's security forces built significant capabilities for national defense against a foreign invasion that has never been likely to come."[20] Perhaps it is time for African nations to build their air forces around defeating internal security threats for which RPAs are well suited and cost effective.

RPA Capabilities to Counter African Irregular Security Threats

With the African internal security threats identified, can RPAs effectively meet these requirements? An RPA's most distinguishing characteristic is the ability to loiter overhead for long periods of time with multiple sensors onboard for varying circumstances. This translates into critical infrastructure protection, counter-piracy, counter-drug, disaster relief, humanitarian aid, search and rescue, and counter-terrorism. All of these missions apply directly to irregular internal threats from non-state actors that Africa faces today. Examining US utilization of RPAs for military and domestic missions illustrate that RPAs have proven extremely effective at these missions, especially the MQ-9. The MQ-9 has multiple variants and sensor configurations depending on the user and mission, to include the newer MQ-9 Extended Range operated by the USAF. For this paper, the MQ-9 designation will be utilized for all variants.

RPAs providing border security is not a new concept and has been a capability of the Department of Homeland Security (DHS) for many years. DHS currently operates 10 MQ-9s on the US southern border and MQ-9s have been utilized on US borders since 2006.[21] Since its initial utilization through 2015, Customs and Border Protection (CBP) officials have credited the MQ-9 in contributing to the seizure of more than 15,000 pounds of marijuana and the apprehension of more than 4,000 undocumented people.[22] The missions that CBP have utilized the MQ-9s include counter-migrant missions, change-detection missions, maritime counterdrug missions (in cooperation with the coast guard), incident-reconnaissance missions, and fixed-target surveillance.[23] In 2009, the Department of Defense began utilizing MQ-9s for anti-piracy patrols in the Indian Ocean.[24]

Another significant African air force requirement is disaster relief and humanitarian aid. The US Air National Guard operates a mixture of 48 MQ-9/1s to provide this capability within the US today. ANG RPA missions have supported multiple relief efforts, to include fire perimeter scans for California fire response in 2013, 2017, and 2018.[25] National Aeronautics and Space Administration (NASA) first started using MQ-9s in support of California wildfires in

2007.[26] CBP also supports humanitarian relief missions within the US, such as the Red River flooding in 2009 and 2010 missions in support of the Federal Emergency Management Agency (FEMA), National Oceanographic and Atmospheric Office, and on the Atlantic coast during the 2008 hurricane season.[27] The main limitation for RPAs supporting disaster relief in the US is the inability to fly unrestricted in the national airspace, which will be discussed in detail later. In 2005, after Hurricane Katrina, MQ-1s from Nellis AFB were ready to mobilize within 48 hours of notification to support disaster relief efforts. However, the Federal Aviation Agency (FAA) would not approve the MQ-1s flight in the un-segregated national airspace so they remained at Nellis AFB.[28] This undoubtedly was a missed opportunity that likely could have saved lives. In 2010, after the Haiti earthquake, it took over two weeks and a presidential order for the FAA to approve MQ-1s to takeoff, land, and transit the national airspace for 15 minutes from Puerto Rico to Haiti.[29] Once approved, MQ-1s provided significant support to relief operations. Although, they could have been better utilized if integrated into disaster relief plans.

Search and rescue is another mission RPAs are very capable of performing. Within the US, the MQ-1 and MQ-9 have supported law enforcement in search and rescue missions on at least three reported occasions since 2012, and many more likely went unreported. The reported occasions occurred in the Lincoln National Forrest, El Dorado National Forrest, and kayakers in New Mexico.[30, 31] Of course, RPAs have been integrated into search and rescue packages for US combat operations for many years. One concern is that RPAs must operate in areas with little terrain and trees to be effective. The first examples mentioned above occurred in forest and rough terrain. A Naval Post Graduate School study in 2013 concluded “the use of UAVs significantly enhances the detection and classification of terrorists operating” in the mountainous region of the Iraq and Turkey border.[32]

RPA's support to disaster relief, humanitarian aid, and search and rescue missions have been limited to finding areas that require assistance, and then directing assistance to them. For all three of these missions, an airdrop capability would increase an RPA's utility. An AFIT study from 2011 showed that an MQ-9, with the integration of a Joint Precision Aerial Delivery Systems (JPADS), is capable of conducting precision airdrops of up to 3750 pounds.[33] Despite each service having a requirement for intra-theater lift to increase responsiveness through on-demand airlift for fewer than 3,000 pounds for the "last tactical mile,"[34] this option was never pursued. However, this capability could have a tremendous impact on disaster relief, humanitarian aid, and search and rescue missions in Africa, which lacks road infrastructure to reach many areas of need. With the exception of an airdrop capability, the disaster relief and humanitarian aid missions are proven and already being accomplish by RPAs.

The below table illustrates the number of MQ-9 flights that were flown in the US by DHS in support of security, search and rescue, disaster relief, and humanitarian assistance from 2010-2012. The number of flights likely have increased since 2012 as DHS acquired more MQ-9s, and the data does not include those flown by the ANG RPAs in support of domestic missions. Using RPAs to support internal security is happening today in the US were the requirements are exponentially lower than in Africa. These same capabilities could be utilized to counter Africa's primary security threats.

Table 2: Domestic MQ-9 Flights 2010-2012[35]

Domestic DHS MQ-9 Flights and Supported Organizations	
Immigration and Customs Enforcement	183
US Coast Guard	134
Drug Enforcement Administration	106
State/Local Law Enforcement	64
Federal Emergency Management Agency	20

Department of Justice	19
Bureau of Land Management	16
U.S. Military	15
U.S. Forest Service	13
Federal Aviation Administration	11
National Oceanic and Atmospheric Administration	6
All organizations (combined) ~700 Total Flights	

The last, and probably most obvious, example of current RPA utilization that could support Africa internal security concerns is the US Air Force's (USAF) armed RPA usage in counter-terror missions. Most will initially think of the headline grabbing airstrikes conducted by RPAs, such as the RPA air strike that killed 60 Shabab terrorist in December 2018. In Somalia alone, there were 27 RPA strikes in 2018 and 35 in 2017.[36] Just as significant, is the ISR capability and loiter time RPAs provide to gain critical intelligence for counter-terrorism. RPAs provide the persistent real time intelligence to direct security forces to the right locations. RPAs are extremely capable at executing a broad spectrum of internal security missions that Africa nations require from their air force.

While very capable against internal security threats, RPAs have limitations. First, they have a very limited impact on external security threats from state actors, or in projecting power outside of one's borders. Other assets would be required to affect this mission. Additionally, while RPA capabilities excel in determining where security forces, disaster relief, humanitarian aid, and search and rescue missions need to be performed, RPAs do not have the capability to transport personnel to those locations. In Africa, with limited road infrastructure, airlift assets to transport troops where they are most needed is a critical need for air forces to compliment RPAs.[37] The Royal Moroccan Air Force is one of a few countries in Africa with an RPA squadron today, operating the Heron made by Israel Aerospace Industries. Morocco utilizes RPAs to counter drugs, immigration, and smuggling.[38] The Uganda Air Force senior officer interviewed believed there was a direct need for an RPA capability in Uganda's Air Force.[39] Although RPAs have a limited role against external state actors, they are very capable for internal security needs, and that is the predominant threat inside Africa today.

Manned Aircraft vs RPA Aircraft Cost Comparison

Having shown that RPAs can meet a developing air force's internal security requirements, the next question is whether RPAs are actually more cost effective and affordable than typical manned aircraft. There are three areas to consider when doing the cost analysis: initial cost to procure the aircraft, sustainment cost, and the cost to train the pilots. Foreign Military Sales (FMS) contracts make it difficult to determine the actual unit cost of aircraft because many other items such as training and spare parts are included in the overall contract. Some nations will get better deals than others depending on their relationship with the US. Key allies typically get a better price than others. For the purpose of this paper, the USAF fact sheets are used for per unit cost. There is some variance in this because the fact sheets are not all based on the same FY dollars. The analysis assumes that the USAF per unit cost difference of differing aircraft would directly translate into a similar cost difference in an FMS contract, or direct military sale. Table 1 below shows that even for the cheapest fighter in the USAF inventory, the F-16, the per unit cost is $18.8M. A twelve aircraft squadron would cost about the same as a fleet of either 44 MQ-1s or 14 of the more capable MQ-9s. When compared to the F-15E, the cost of 12 aircraft equates to 74 MQ-1s or 24 MQ-9s. The cost savings increases further when compared to 5th generation fighters. If considering the RQ-4, there is no savings. There is a significant procurement cost saving in MQ-1/9s as opposed to fighter aircraft.

Sustainment may be the most significant portion of overall life-cycle cost for an aircraft. For this analysis, the ACC/A3 cost per flying hour is utilized. While the cost per flying hour does not cover all sustainment items, it is a very good indicator and can highlight differences in cost across aircraft types. Again, the F-16 is the USAF's least expensive 4th generation fighter in term of cost per flying hour, but is still over $7,500 more per hour than an MQ-1 or MQ-9, and $7,400 more per hour than an RQ-4. The F-15E is over $14,000 more per hour than the other RPAs. The F-22 and F-35 are currently less per hour than the 4th generation fighters, but still over $5,500 more per hour than RPAs. These numbers show a clear sustainment savings with RPAs, assuming other factors not calculated in the cost per flying hour are neutral across platforms.

Pilot training cost is the final consideration. For manned pilots, the pilot training cost varies depending on the mission type. In the USAF, fighter pilots cost the most to qualify at between $3.6M - $4.7M per pilot (assumes F-16 initial qualification training (IQT) cost the same as IQT for all other fighters). Next, bomber pilots cost $680K not including IQT cost (info not available) which would likely at least double this figure. Mobility pilots range from $620K - $720K depending on the specialty. Manned pilots rely heavily on actual flight time in order to acquire the "seat of the pants" feel to flying. As a result, the percentage of simulator training is low in comparison. Conversely, RPA pilots initially have some actual flight time, but then rely predominantly on the simulator for the vast amount of training. ACC/A3M MQ-1/9 Branch Chief, Major Arens, puts the percentage of simulator training for RPAs at 65%, with a target to eventually reach 95%.[40] As a result, the cost to qualify an RPA pilot is $58.3K, not including IQT. Obviously IQT adds to this cost, but even if the cost doubles, there is a savings of between $500K - $4.6M per pilot, depending on the specialty. Training cost savings can have an even larger impact depending on the crew ratio and number of pilots required for the platform. Additionally, if the Ground Control Stations (GCS) are designed similarly, there is more flexibility, less training, and less cost required to transition pilots from one RPA type to another, as compared to one manned aircraft type to another. As an example, prior to the Air Force divesting from MQ-1s (December 2018), many MQ-9 and MQ-1 pilots were dual qualified, and would fly MQ-1 and MQ-9 missions in the same day.[41]

Not all developing countries will have the same budget to build an air force. Depending on a country's size and security considerations, the number of RPAs required will vary. For this reason, the cost of a 24-hour CAP is important because the cost can be extrapolated out to an air force's requirements and budget. For this vignette, a country chooses to procure the MQ-9 to gain an armed option, extra payload capability, synthetic aperture radar capability, and the potential to integrate an air-drop capability. A 24-hour CAP requires four MQ-9s at a procurement cost of under $64.2M. While it would only take two MQ-9s to cover 24 hours, the other two MQ-9s are needed as spares for maintenance. The more aircraft available, the less likely a maintenance issue or depot level maintenance will impact the mission. Six pilots would be required for a 24-hour CAP. This allows eight-hour shifts and the ability to take breaks as well as extra pilots for leave and illness. Initial pilot training cost would be $350K. Assuming 365 days a year and 24 hours a day, the annual sustainment cost is under $1M (utilizing cost per flying hour numbers). Total cost for procurement, initial training, and a year of sustainment for a single 24-hour CAP is $65.6M. A single MQ-9 can stay airborne for 22-hours at a time compared to about 2.5-hours for a fighter aircraft. Additionally, the Air Forces average mission capable rate, the rate at which an aircraft can fly and execute its mission, excluding the MQ-1/9 is 70%. The MQ-1/9 is at 90%.[42] This means the MQ-9 will provide more hours of overhead coverage and more often be capable of executing the mission. There is a significant savings over the lifetime of the aircraft from initial procurement, sustainment, and training for RPAs over traditional manned aircraft. Due to the spectrum of missions and time on station the MQ-9 provides, the MQ-9 brings more capability to bear when considering internal security. This makes RPAs much more affordable for developing countries building an air force with a limited defense budget.

Table 1: Manned and RPA cost Comparison

Aircraft Type	Unit Cost[43] (M)	Sustainment[44] $/hr (FY19)	Pilot Training Cost[45] (FY14)	Notes
MQ-1	$20.0	$98	$58,330	- Unit cost based on FY06 dollars - Includes 4 a/c, GCS, sensors, and comm - Initial pilot training only, not IQT
MQ-9	$64.2	$98	$58,330	- Unit cost based on FY06 dollars - Includes 4 a/c, GCS, sensors, and comm - Initial pilot training only, not IQT
RQ-4	$123.0[46, 47]	$255	$58,330	- Unit cost is FY15 dollars - Initial pilot training only, not IQT
F-15C	$29.9	$15,179	$3,601,885	- Unit cost is FY98 dollars - Pilot training assumes similar cost as F-16 IQT
F-15E	$31.1	$14,358	$3,601,885	- Unit cost is FY98 dollars. - Pilot training assumes similar cost as F-16 IQT
F-16	$18.8	$7,643	$3,601,885	- Unit cost is FY98 dollars
F-22	$143.0	$6,299	$4,758,344	- Pilot training assumes similar cost as F-16 IQT
F-35	$89.2[48]	$5,740	$4,758,344	- Unit cost is FY18 dollars - Pilot training assumes similar cost as F-16 IQT
C-130	$75.5	$3,649	$719,083	- Unit cost is based on FY17 dollars

Export Regulation

If developing air forces are going to build around RPAs to capitalize on the growing capabilities, dynamic mission sets, and reduced cost compared to other tactical aircraft, then the US must make changes in its export policies and international agreements in order to sell RPAs through FMS or direct commercial sales. Otherwise, the US will be unable to capitalize in the expected growth in the market, will lose an opportunity to increase the capabilities of our allies, and will miss an opening to gain further influence in these developing air forces. According to a RAND study, the global RPA market will double from $6 billion to $12 billion by 2025.[49] Unfortunately, US policy and treaty agreements put US companies at a significant competitive disadvantage in exporting these systems.

The Missile Technology Control Regime (MTCR) is the biggest contributor. The MTCR was established in 1987 with the aim of slowing proliferation of ballistic missile technology and delivery vehicles able to deliver weapons of mass destruction (WMD). It is a voluntary, multilateral export control regime with 35 signators which covers missiles and unmanned systems such as RPAs.[50] Of particular concern is the classification of Category 1 systems, defined as missiles and related technologies capable of carrying a 500-kilogram payload at least 300 kilometers.[51] According to the 2017 MTCR handbook, there is currently not an airspeed designation for Category 1 systems.[52] Exporting these systems requires overcoming a "strong presumption of denial." Which essentially means that any signator country to the MCTR must have a very compelling case to export Category 1 systems, which should occur "only on rare occasions," and require binding and vigorous government-to-government assurances on end-use.[53] While this makes sense for missiles, unfortunately, the broad definition also covers many US RPAs such as RQ-4, MQ-1, and MQ-9. Classifying RPAs the same as missiles ignores an important distinction. Missiles are one-way weapons whereas RPA, in most circumstances, are recovered and reutilized. The military missions of an RPA can range from air refueling, potentially air drop, border security, anti-terrorism, and reconnaissance to name a few. RPAs also have commercial purposes such as agriculture and infrastructure security. The MTCR limits exports of these Category I systems regardless of intended military or commercial use.

When US companies are unable or are limited in the exports of these Category 1 systems, they can potentially lose a competitive edge to other nations both in market share and technology perspective.[54] US industry has been the global leader in RPA technology, however, other nations have been incentivized to catch up. The US has denied FMS cases for Category 1 systems to Saudi Arabia, Jordan, UAE, Turkey, Iraq, and Algeria.[55] All of these countries went to China to acquire similar capabilities. Since FMS case denials are difficult to track, there could be more denials. Countries wishing to pursue Category 1 systems may not have even started the formal FMS request process with the US because of the MCTR restrictions.[56] In total, 15 nations have gone to China or Israel, instead of the US, for similar capabilities to Category 1 RPA systems. To date, the US has only exported Category 1 systems to close allies South Korea, France, Italy, Japan, NATO, Spain, India, Australia, and UK, but only armed RPAs to Spain, Italy and the UK.[57] Of note, all these nations are signators of the MTCR. To date, the US has not exported any Category 1 systems to non-signators. The result has been countries either start an indigenous program, or turn to other sources to acquire such capabilities. China and UAE export Category 1 systems, but also will likely be the first to offer production facilities in other countries, a MCTR restriction.

The advantages for the US to open the aperture to increase exports of these systems is obvious: increased US jobs through increased FMS and direct commercial sales, increased capability and inter-operability of our allies, potential decreases in US government per unit cost, retaining technological edge over other nations, and gained influence into more partner air forces. Another key advantage is in research and development investment. As RPAs are more proliferated, R&D will be key to expanding the capabilities and missions of RPAs. If US exports are restricted as they are today, innovative new RPA capabilities will be stymied due to lack of

R&D. One example is airlift or cargo. Any RPA designed for airlift would most likely be classified as a Category 1 system due to the range and tonnage requirements. Without the incentive to export for commercial or military use, US companies could very well fall behind in these areas.[58] As mentioned previously, the USAF did not pursue an airdrop capability from the MQ-9 despite the AFIT study, but the capability still might have been developed if US companies could have sold it to our partners. China and the UK are already developing an RPA with a payload capability of over one ton. The current MCTR agreement puts US companies at a disadvantage to export many RPA systems. These RPA systems are exactly the capability developing air forces and nations in Africa should be purchasing for internal security threats.

The Trump administration has taken a few actions to remove the handcuffs. For US export policy, which is much easier to change than the MCTR, the administration, in April 2018, released new guidance for export of defense equipment which loosens export restrictions. First, the administration opened the option to sell RPAs via Direct Commercial Sales. This allows nations to negotiate directly with US companies and avoid the red tape and more time-consuming Foreign Military Sales process.[59] Of note this only would apply to RPAs below the Category 1 threshold of the MTCR. Second, strike-enabling technology, such as laser target designators, were reclassified from armed to unarmed making it easier to export them.[60] With regards to the MCTR, the administration has indicated that at the next meeting, November 2018, it will request an amendment to the Category 1 designation. While unable to confirm the specifics about the requested change for proprietary reasons, the expected request will be to add a speed requirement for Category 1 of 650 km/hr.[61]   This would ultimately remove most US military RPAs from the Category 1 designation, but the request must be agreed upon by all 35 signator nations in order to implement. The current Category 1 designation of the MCTR would inhibit developing countries from building their air force around US RPA capabilities and it must change.

RPA Integration into the UN-Segregated National Airspace

Most developing air forces will focus on internally security missions such as anti-terrorism, criminal smuggling, piracy, humanitarian missions, and air drop as opposed to projecting power outside its borders. For this reason, in order to build an air force around RPA capabilities, RPAs must be able to operate anywhere within a nation's borders. An RPA's inability to "see and avoid" has resulted in many operational limitations, or complete exclusion within a nation's airspace. Within the United States, these rules and regulations are governed by the Federal Aviation Administration (FAA), internationally they are governed by the International Civil Aviation Organization (ICAO), and most countries will have an FAA equivalent. Within Africa, there are multiple governing organizations such as the South African Civil Aviation Authority (SACAA). Even within the US, with the world's most capable systems, RPAs can fly unlimited only within segregated airspace (restricted airspace and military operating areas) where civilian air traffic is restricted. However, RPA flight within the un-segregated national airspace, where civilian traffic is mostly located, requires special approval. According to Major Arens, for RPAs to fly in the un-segregated national airspace requires prior coordination with the FAA for a Certificate of Authorization (COA). The COA requires 60 days advance notification, sometimes it takes more than 60 days for approval, and in emergency situations it can take less time.[62] Once approved the COAs are valid for up to one year.[63] The RQ-4 is the only RPA which does not have to follow COA policy largely because it flies well above civilian traffic.[64]

The critical factor that currently does not allow RPAs to fly in the un-segregated national airspace is safety, the ability to "see and avoid" mid-air collisions. Internationally, in today's civil airspace, the possibility of mid-air collisions is nearly eliminated by multiple layers of procedures, redundancies, and technologies. There are two groups that provide this level of safety. The first is safe separation of aircraft within the un-segregated airspace, and the other is avoiding a collision in cases where sufficient safe separation was not provided.[65] Safe separation utilizes a web of redundant system consisting of ground radar, transponder signals announcing aircraft location, cockpit communications, air traffic control, instrument flight rules, and airspace classifications.[66] For the RPAs being addressed in this paper, the first level, safe separation, is already in compliance. The RPA systems discussed already are equipped with the necessary equipment to meet this criterion. When safe separation rules from the controlling agency break down, then "see and avoid" systems are the back up. The first issue is that RPAs lack a pilot's eyes, which is the last line of defense for avoiding a collision. Additionally, the same transponders that emit the aircrafts location can warn of conflicting flight trajectories, Traffic Alert and Collision Avoidance System (TCAS) will alert and suggest a maneuver to the pilot, and onboard radar can highlight the location of aircraft to the pilot. In all these cases, the pilot in command must still take timely action, which is where another issue with RPAs arise. RPAs are reliant on communication links to get the pilot's command from the ground control station to the aircraft and a multitude of impacts can make the collision avoidance maneuver untimely.[67]

General Atomics Aeronautical Systems (GA-ASI) is cooperating with the FAA, NASA, and ICAO, in the development of a MQ-9 variant which will bring RPAs into regulatory compliance by 2020.[68] GA-ASI intends to integrate the Detect and Avoid (DAA) system into all its aircraft including foreign sales. GA-ASI is adding required equipment such as anti-ice and lighting protection as well as a series of sense-and-avoid systems to meet FAA-designated DO-365, "Minimum Operational Performance Standards for Detect and Avoid Systems."[69] This will also meet ICAO Annex 2 requirements.[70] To meet see and avoid requirements, a GA-ASI developed airborne radar is coupled with TCAS II, a DAA tracking capability, Automatic Dependent Surveillance Broadcast (ADS-B), identification of friend or foe (IFF), and a conflict prediction and display system.[71] The information is fused to provide automatic collision avoidance with the ability for the pilot to remain clear of other airspace users. Additionally, the same information is transmitted to air traffic control (ATC) and other aircraft in a similar manner as manned aircraft allowing safe operations with civil traffic even when the link to a ground control station becomes inoperable.[72] GA-ASI is well on its way to having an international air worthiness certification for its RPAs by 2020. To date, GA-ASI has conducted at least four publicly known test flights with the new DAA system, and GA-ASI is working with the UK, Japan, and international aviation regulators to incorporate RPAs into the civil un-segregated airspace.[73, 74, 75, 76] Once RPAs are fully integrated into the national airspace, it will open the doors to building an air force around RPA capabilities. With 2020 as the target date for GA-ASI to have approvals in the US and other international locations, it will not be long after for areas such as Africa.

Recommendations and Conclusion

African countries, and other developing nations, are in a security situation where the existential threats are not from external actors, but instead from internal irregular threats such as terrorism, unregulated borders, ungoverned spaces, criminal smuggling, and humanitarian crisis. With the increasing cost to build and sustain a capable air force, alternative methods are required for nations without the budget to afford a high-end air force. RPAs can be an ideal fit at a lower cost, and most often offer a wider, more flexible range of capabilities in these missions. The current and future RPA capabilities can address most internal security air force missions to include ISR for border security, counter-terror, counter-piracy, and other criminal behavior; and support humanitarian aid such as search and rescue and potentially air-drop missions. RPA capabilities will only continue to expand in the future and these air forces would be well postured to take advantage. RPAs have their shortfalls, and other assets will be required to address any external security threats and to provide airlift until an RPA capability is developed. In order to gain the full potential of building an air force around RPAs, several changes need to occur. First, the US must fight to change the MTCR Category 1 definition to make it easier to export RPAs to nations that want to build an RPA capability. If that is untenable, then the US should withdraw from the MCTR. Currently, the process is too long and too restrictive, and results in nations seeking other opportunities when the US turns them away. This would also benefit the US RPA industry as well as expand US influence in these nations. Second, RPAs must be integrated in national airspaces internationally. Once this occurs, RPA capabilities and utilization will see a drastic increase. Currently, RPA capabilities and utilization are restricted to a very limited airspace, if allowed at all. With these two changes implemented, the conditions for developing countries to build an air force around RPA capabilities will be set. A common phrase in Africa is "African solutions to African problems." By building an air force around RPAs, African nations will be better postured to provide for their own internal security and not be as reliant on other western nations.

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