Journal of Applied Security Research

ISSN: 1936-1610 (Print) 1936-1629 (Online) Journal homepage: www.tandfonline.com/journals/wasr20

Autonomous Weapons Systems in Africa: Emerging Realities, Prospects, and Risks

Samuel Oyewole, Christopher Isike, Tony Oche & Ezenwa E. Olumba

To cite this article: Samuel Oyewole, Christopher Isike, Tony Oche & Ezenwa E. Olumba (12 May 2025): Autonomous Weapons Systems in Africa: Emerging Realities, Prospects, and Risks, Journal of Applied Security Research, DOI: 10.1080/19361610.2025.2501055

To link to this article: https://doi.org/10.1080/19361610.2025.2501055

Published online: 12 May 2025.

JOURNAL OF APPLIED SECURITY RESEARCH
https://doi.org/10.1080/19361610.2025.2501055

Autonomous Weapons Systems in Africa: Emerging Realities, Prospects, and Risks

Samuel Oyewole[a,b], Christopher Isike[a], Tony Oche[a], and Ezenwa E. Olumba[c]

[a]African Centre for the Study of the United States (ACSUS) and the Department of Political Sciences, University of Pretoria, Pretoria, South Africa; [b]Department of Political Science, Federal University Oye-Ekiti, Oye-Ekiti, Nigeria; [c]Department of Politics and International Relations, Royal Holloway, University of London, London, United Kingdom

ABSTRACT

There are inadequate African perspectives on the development, adoption, testing, deployment, and utilization of (lethal) autonomous weapons systems (L/AWS) by African countries or foreign military powers on the continent. Accordingly, this article explores the emerging trend of AWS in Africa, its potential military and strategic benefits, and the risks for the continent. Using content analysis of publicly available data and structural phenomenological analysis of formal and informal engagements with some stakeholders, the article examines the emerging realities of AWS in Africa, including local production, capacity building, foreign procurement, testing, deployment, and operations of weapons with autonomous features. L/AWS has the potential to boost intelligence, surveillance, and reconnaissance (ISR) capabilities, precision, and effectiveness of coercive operations, and minimize military casualties and operational cost of troubled African countries. Nevertheless, the risks posed to human rights, democracy, national security and sovereignty, and regional stability by AWS adoption and deployment in Africa cannot be ignored. Hence, this article advocates for a cost-benefit approach to AWS adoption and deployment in Africa.

KEYWORDS

Africa; Artificial intelligence; autonomous weapons systems; military; security

Introduction

On 12 October 2007, at the South African National Defense Force (SANDF) Battle School in Lohatla, Northern Cape, a tragic incident occurred during a training exercise that proved epochal in understanding

CONTACT Samuel Oyewole samueloyewole47@yahoo.co.uk, samuel.oyewole@up.ac.za African Centre for the Study of the United States (ACSUS) and the Department of Political Sciences, University of Pretoria, Lynnwood Rd, Hatfield, Pretoria 0002, South Africa.

automated weapons in Africa. A computerized GDF Mk V twin 35 mm cannon system malfunctioned and began firing live ammunition uncontrollably, resulting in the deaths of nine soldiers and the injury of 14 others (Engelbrecht, 2007; Shachtman, 2007). While the incident was believed to be a software error, it also suggested a mechanical failure (Simonite, 2007). Regardless of the cause, this incident highlighted one of the dangers associated with automated and possibly autonomous weapons: anyone and everyone could be a target, even those meant to control them. Beyond automation, autonomous weapons can execute orders with considerable operational autonomy according to their design and available data.

With the emerging age of Artificial Intelligence (AI) and the geopolitical demands for their military applications, the interests of policymakers, strategists, and corporate partners and investors in (lethal) autonomous weapons systems (L/AWS)[1] and other emerging military technologies have surged globally (Hoffman et al., 2016; King, 2024; Wyatt, 2020). These developments have accelerated research, development, and innovation of weapons with autonomous features in air, land, and sea reconnaissance and warfare. In this case, the USA, China, Russia, Israel, the UK, France, Türkiye, Ukraine, and South Korea are among the leading countries in research, development, testing, and deployment of AWS. In addition, L/AWS have featured prominently in recent military campaigns, such as the Israel-Gaza and Russia-Ukraine wars.

The development, testing, deployment and utilization of L/AWS has generated numerous concerns, including policy, military, strategic, political, economic, technological, and ethical debates (Coeckelbergh, 2019; Guha & Galliott, 2023; Hoffman et al., 2016; Iwan, 2022; Riesen, 2022; Rosendorf et al., 2024). However, the knowledge of L/AWS is dominated by the experiences and perspectives of technologically advanced countries such as the USA, China, Russia, Israel, and Europe, although there is a growing contribution from a few emerging countries in East Asia, India, Brazil, and Iran (Badell & Schmitt, 2022; Chansoria, 2016; Russell, 2023; Santos, 2016; Wyatt, 2020, 2021). Accordingly, there is inadequate scholarship from Africa and many other developing countries on AWS, their benefits and risks, perhaps due to their limited development, adoption, and deployment of such weapons (Chengeta, 2016; Heyns, 2017; Udoh, 2024). As shown in this article, however, this trend is slowly changing, as some African countries are embracing the idea and use of such weapons or becoming testing grounds for externally produced, displayed, supplied, and/or utilised AWS (African Defense Forum, 2025; DefenceWeb, 2025; Olumba et al., 2024: UNSC, 2021).

Indeed, some African and other developing countries of the Global South are increasingly embracing research and innovation in the field of

Artificial Intelligence (AI), including for military purposes, which could be explored further for the design and development of AWS (Hespress, 2023; Lionel, 2023; SAAIA, 2024). As evident with most other weapon systems, countries without research and production capacity could acquire AWS through aid, investment, and procurement, or become display and testing grounds and theaters of operation for foreign powers. As such, the Government of National Accord (GNA) of Libya acquired Tukish-made Kargu-2 (Unmanned Combat Aerial Vehicles (UCAV) with autonomous flight and targeting capacity) and used it in a military operation in 2020, while the US Navy displayed the capacity of Triton surface/subsurface autonomous drone in a multilateral excerice in the coast of Gabon, West Africa in 2024 (Edy, 2024; Lionel, 2024a; Olumba et al., 2024; UNSC, 2021). In the last two decades, about 19 African countries have acquired Unmanned Aerial Vehicles (UAVs) with different levels of autonomy. These scenarios represent the emerging realities of L/AWS in Africa, which necessitate a careful assessment of the cost/risks and benefits of this development.

Drawing from the recent cases of testing, deployment, and utilization of AWS in Africa, this article examines the realities, prospects, and risks of such emerging military technologies on the continent. As evident in this study, the adoption, deployment, and utilization of AWS have the prospects to minimize military casualties, collateral death and damage, and cost of operation, as well as bridge the development gap and enhance the strategic advantage of the continent. However, they can also undermine human rights, democracy, national security, sovereignty, and regional stability in Africa. Beyond this introduction, this article is further divided into six sections, including conceptual clarification, methodology, realities and known cases of L/AWS in Africa, the prospects and emerging opportunities, the risks and challenges, and the concluding reflection.

The concept of autonomous weapons systems

A weapon generally means a tool, object, means, and instrument of harm and damage to humans, animals, and the environment, especially while resolving differences in a fight or war. Human evolution is characterized by a history of conflicts and warfare, shaped by available weapons across time and space. From simple stone, rock, and stick to bow, arrow, sword, spear, horse, and then ship, gun, tank, aircraft, and missile, as well as atomic, biological, and chemical (ABC) weapons, the human resolve to develop increasingly disruptive and destructive weapons have come of age. Hence, the emerging trend of autonomous weapons could be located in the long chain of weapon development across human history.

It is important to note that there is no universally acceptable definition of autonomous weapons. Scholars and policymakers face the challenge of defining what constitutes L/AWS (Altmann & Sauer, 2017; Wood, 2023). AWS, according to the United Nations Office for Disarmament Affairs (UNODA) (2023), requires "autonomy" to perform its functions in the absence of direction or input from a human actor. This broad definition allows the UNODA's AWS conception to include anti-personnel and anti-vehicle mines that operate autonomously upon trigger when activated; missile sentry and defense systems that can autonomously detect, warn, and engage targets; and loitering munitions (such as drones) that can await, locate, and engage targets. However, most of these weapons are better described as automated weapons, which operate as preprogrammed. While the line between automated and autonomous weapons is blurred, the integration of AI into the latter makes the difference. Hence, autonomous weapons enjoy autonomy in their operational decisions, as they can be designed to take and alter the course of actions based on their general programming and available data without human interference.

According to Altmann and Sauer (2017), autonomous weapons can "… operate without human control or supervision in dynamic, unstructured, open environments, attacking various sets of targets, including inhabited vehicles, structures, or even individuals. They will operate over an extended period of time after activation—and will potentially be able to learn and adapt their behavior." In contrast, automated weapons "repeatedly perform pre-programmed actions within tightly set parameters and time frames in comparably structured and controlled environments" (Altmann & Sauer, 2017, 118). Taking into account their lethal dimension (LAWS) as well, Taddeo and Blanchard (2022, 37) observed that autonomous weapons systems are:

> an artificial agent which, at the very minimum, is able to change its own internal states to achieve a given goal, or set of goals, within its dynamic operating environment and without the direct intervention of another agent and may also be endowed with some abilities for changing its own transition rules without the intervention of another agent, and which is deployed with the purpose of exerting kinetic force against a physical entity (whether an object or a human being) and to this end is able to identify, select or attack the target without the intervention of another agent.

The above definition indicates that AWS is bound to use AI models to act autonomously. AI is not a singular technology, and neither is it a weapon in itself (Bode & Watts, 2023; King, 2024). It is a technological enabler influencing various human domains, including transport, marketing, healthcare, finance, security, science, education, entertainment, agriculture, and manufacturing (Bode & Watts, 2023; Coeckelbergh, 2019). While AI has many benefits, it raises ethical issues at both individual and societal levels, particularly when it enables machines to perform human tasks, including combat and killing (Coeckelbergh, 2019; Guha & Galliott, 2023; Hoffman et al., 2016). However, AI-enabled weapon systems do not simply mean that AWS is totally autonomous of human, but have varying degrees of autonomy or automation, based on their design, programming, and development. This is responsible for the growing realization of the difference between autonomous and semi-autonomous weapons. The enduring relevance of humans in command and control, including in acquisition, deployment, maintenance, mission planning, and supporting systems, suggests that fully autonomous weapons are still futuristic (Amoroso & Tamburrini, 2021; Ferl, 2024; Gillespie, 2020).

Importantly, there is a notable difference between autonomous weapons and autonomous weapons systems (AWS). A system is made up of different components, and cannot be reduced to a unit. Beyond the weapon components, AWS are built around an entire system that makes them operationally active and responsive, including the algorithms and supporting infrastructures behind their artificial intelligence and actions (Austero et al., 2020; Flinders & Smalley, 2024). For instance, the Israeli Lavender in/famously aids the tracking and identification of 37,000 suspected Hamas militants for precision strikes and assassinations with an AI-powered database (Abraham, 2024), is one of the components of the system featured in such operational decisions and actions. Dynamics in decisions and actions of AWS are functions of massive and complex data processing, which are best hosted, managed, and secured using supercomputers that are usually energy-consuming. Beyond the operational or tactical components, the systems and infrastructures behind the AWS are strategic in this consideration.

AWS can be used for defensive and offensive purposes. As an object of defence, AWS such as aerial, surface, and subsurface platforms and their cyberspace enablers are relevant for intelligence, surveillance, and reconnaissance (ISR). This is the case of the Triton surface/subsurface drone dispalyed/operated by the US Navy in West Africa. Some aerial and surface autonomous robotic platforms such as A Trustworthy Robotic Autonomous System to Support Casualty Triage (ATRACT) are promising projects to support the military in a medical evacuation from the frontline, and some others in neutralizing mines ahead of advancing troops (Krygier et al., 2024). However, there is growing attention for offensive AWS, otherwise known as LAWS. These are platforms that can autonomously identify, target and neutralize "hostile" forces and their facilities. This is the case of Turkish STM Kargu-2 and its deployment in Libya (Olumba et al., 2024; UNSC, 2021). However, there is a thin line between defensive and offensive weapons (Guha & Galliott, 2023; Haas & Fischer, 2017; Warren & Hillas, 2020). This is evident in the case of Israeli AI-enabled weapons in the military campaign against Hamas in Gaza. Targets were eliminated by manned and unmanned platforms based on AI-powered and weaponised databases of intelligence gathered and processed by Lavender, "The Gospel" and "Where's Daddy?"[2] (Abraham, 2023, 2024; Human Rights Watch, 2024).

For this article, an autonomous weapon system can be broadly described as an agent capable of receiving and executing military and strategic orders with considerable autonomy (without human intervention) in operational decisions, including the ability to self-regulate speed, trajectories, and positions to gather and analyze intelligence, define, evade, and possibly engage and eliminate threats, insert and evacuate personnel and/or deliver supplies. In this case, the ability to engage and eliminate threats is a unique feature of the lethal autonomous weapon system. Hence, LAWS is an agent or war machine equipped with artificial intelligence or self-regulating abilities (algorithm) to gather and analyze data required to define what constitutes threats and how to evade, engage, and eliminate them without human intervention. In contrast, a non-lethal autonomous system is a military or dual-use machine with the ability to make relevant decisions without human intervention, while mapping the environment, searching, locating, identifying, labeling, monitoring, and evading hostile forces, delivering supplies, inserting or evacuating personnel in the theater of operation. While the level of autonomy varies, there is a growing number of weapons with specific autonomous features. As a system, the existing autonomous weapons are integrated aerial, surface, and subsurface machines with components connected and responsive to internal and external sources of command and control through computers and communications based on intelligence, surveillance, and reconnaissance (C4ISR).

With the emphasis on offensive capabilities (LAWS), ethical, legal, and humanist scholars are skeptical of AWS and have challenged the development, adoption, deployment, and use of such killing machines (Ferl, 2024; Guha & Galliott, 2023; Hoffman et al., 2016; Jones, 2018; Limata, 2023). They are mostly concerned that the LAWS are not really compatible with the humane bases of international law of war as coded in the Geneva Conventions and Protocols on Armed Conflicts and human rights in conflict zones, as well as transparency and democracy (Blanchard & Taddeo, 2022; Iwan, 2022; Omohundro, 2014; Rosendorf et al., 2024). These have inspired advocacies for banning, regulating, and safeguarding the development, adoption, and deployment of AWS (Chansoria, 2016; Kohn et al., 2024; Prem, 2022; Warren & Hillas, 2020). However, realists are more concerned about the contributions of AWS to military capabilities and national security of a state, and international balance of power and stability (Galliott

& Wyatt, 2022; King, 2024; Riesen, 2022; Wyatt, 2020, 2021). Amidst these, notable African and post-colonial perspectives have emerged on the threats of AWS to human rights and the need to regulate them (Chansoria, 2016; Chengeta, 2016; Heyns, 2017; Santos, 2016; Udoh, 2024). However, there is limited reflection on African and post-colonial realities, (potential) costs, and benefits. To address this gap, the next section provides insight into the methodology.

Methodology

The article primarily relies on publicly available data (secondary sources), which are analyzed using content analysis, exploring the communication of actual and potential costs/risks and benefits of L/AWS in Africa. Using a structural phenomenological approach, the interpretation of publicly available data and the analysis also benefited from our experiences as participants in formal events and informal conversations with relevant stakeholders in the policy, aerospace, AI, and defence sectors in several African countries and outside the continent over the last decade. Structural phenomenological approach is a qualitative method of understanding a subject and the underlying structures from the experiences and sense-making of individuals (Brown, 2005). It involves coding data pieces that are merged into categories, refined through several iterations of cases, and explored for the relationships or patterns across categories, to identify relevant themes to understand the context and the object of study (Ary et al., 2014).

The analysis also adopts transdisciplinary and theory-driven approaches, which reflect a combination of cost-benefit analysis (policy studies), military and strategic, military sociology, realist (international relations), liberal democratic (political science), and political economy perspectives on the subject. Cost-benefit analysis assesses decisions based on actual or potential/projected benefits and cost implications (Melese et al. 2015). The military and strategic perspective focuses on threat assessment, goal setting, planning, and actions to realize the desired objectives, while military sociology involves the social dynamics within the military and around its relations with society (Omotola et al., 2023). Realism assumes that power is central to state survival in the international system. Hence, it encourages states to be self-reliant and always strives to enhance their power capabilities relative to others (Ogunnubi and Oyewole, 2020). Political economy deals with the interface of political and economic forces, interests, and systems, while liberal democracy limits government power and promotes individual rights and freedom (Omotola et al., 2023). On these bases, the next section reflects on the emerging realities of L/AWS development, acquisition, and deployment in Africa.

Emerging realities of L/AWS in Africa

Many things about L/AWS, their developments, tests, deployments, and operations, like most other subjects in military studies, are shrouded in mystery. This includes the extent to which African states are involved in the development, adoption, testing, and employment or utility by foreign powers as testing grounds of L/AWS. For instance, Libya's acquisition of Turkish STM Kargu-2 was unknown until it was uncovered by the UN Panel of Experts tasked with reporting compliance to Security Council Resolution 1973 (2011), which includes a no-fly zone, an arms embargo, and other sanctions (UNSC, 2021). Accordingly, such weapons transfer and deployment could have gone unnoticed elsewhere without UN sanctions and reporting. Although many African countries are against the development of AWS, and the common African position is skeptical of such capabilities, it is worthwhile to explore relevant developments in the area. Accordingly, this section explores (1) adoption, acquisition, and development of L/AWS in Africa, and (2) deployment, testing, and operations of L/AWS in Africa.

L/AWS adoption, acquisition, and development in Africa

Notably, there is a growing African interest in AI-enabled weapons, armed forces, and warfare. At the 68th anniversary of the Royal Moroccan Armed Forces in May 2024, King Mohammed VI called for the establishment of a new college and comprehensive reevaluation of the curricula and training programmes for the military to reflect emerging challenges and opportunities, including in AI (Arredondas, 2024). In December 2023, the Moroccan military declared interest in collaborating with Mohammed VI University of Technical Sciences in developing AI-enabled UAVs (Hespress, 2023). In September 2023, the Nigerian Chief of Naval Staff announced a 2035 roadmap for adopting AI-enabled capabilities (Lionel, 2023). Equally, the Chief of Air Staff of Nigeria declared the intention of the service to leverage the AI revolution for future warfare (NAF, 2023), while the Chief of the Army declared interest in AI-enabled "smart soldiers" (Lionel, 2024b). In addition, South Africa established the Defence Artificial Intelligence Research Unit (DAIRU) to annex available government, private, and military resources for defence and security purposes (SAAIA, 2024; Wingrin, 2024). However, the extent to which these shows of interest and commitment point to the African quest for capacity in the development and adoption of AWS is a subject of debate.

For a better insight into AWS acquisition and adoption, we explore the SIPRI Arms Transfers Database (updated in March 2025) for records of major suppliers globally for arms transfers between 2000 and 2024, from where we extracted data for transfers of UAVs and UCAVs to Africa. Using a combination of official records of manufacturers and military-related media, we tracked the key features of all supplied UAVs and UCAVs to Africa to arrive at the list of platforms with varying degrees of autonomy in Tables 1 and 2. Accordingly, the African Union and 19 countries on the continent have purchased different brands of UAVs and UCAVs with varying degrees of autonomy. These countries include Algeria, Burkina Faso, Cameroon, Chad, Cote d'Ivoire, Djibouti, DR Congo, Egypt, Ethiopia, Kenya, Libya, Mali, Morocco, Niger, Nigeria, Sudan, Togo, Tunisia, and Zambia. Prominent among such UAVs are Aerostar, Anka, CH-4A, Hermes-450, Heron, ScanEagle, and ThunderB, while the UCAVs include Ababil-3, Akinci, Aksungur, Bayraktar TB-2, CH-3, CH-4B, Wing Loong-1, and WJ-700. The continent has purchased 167 of such platforms worth US$ 404.36 million. These platforms were supplied to Africa by China, France, Iran, Israel, Turkiye, and the United States. Amid these, Turkiye supplied 78 platforms (about 46.7 per cent) for US$ 200.2 million, while China supplied 53 (31.7 per cent) for US$ 191.8 million.

Few African countries have developed relevant capacities for designing, developing, and producing military or dual-use platforms with varying degrees of autonomy. South Africa maintains the most advanced aerospace and defence industry on the continent. Amid these, a South African-based company, Milkor, has independently developed the Milkor 380, a UAV with ISR system capabilities, including manual and full autonomous flight capability (Milkor, 2025; Wingrin, 2024). The Egyptian-based company Robotics Engineering Systems (RES) has also unveiled the "6th of October" UAV with automatic takeoff and landing capabilities (Samir, 2024). The Morocco-based company, Aerodrive Engineering Services (AES), also developed the Atlas Eastar I UAV, which is reportedly fully autonomous (Hespress, 2024). Although Nigeria has not yet produced a UAV with autonomous features, it earlier produced a military UAV and reportedly opened the largest drone factory on the continent in 2024 (Lionel, 2024c). These, among others, trends indicate the potential and emerging realities of UAVs and, most importantly, AWS developments and adoptions in Africa.

L/AWS deployment, testing, and operations in Africa

Weapons or assets with autonomous features have received significant attention in military capabilities, deployments, training, and operations in Africa. For instance, Burkina Faso, Ethiopia, Libya, and Mali have acquired and deployed the Turkish Akinci & Bayraktar TB-2 UCAVs with advanced autonomous features. The Nigerian military also operates the Chinese CH-

Table 1. Major weapons with autonomous features, their suppliers and recipients in Africa, 2000–2024.

Designation	Suppliers	Recipients	Total	Delivery value	Specification
Ababil-3 UCAV	Iran	Sudan	2	0.4	Automatic take-off and landing
Aerostar UAV	Israel	African Union, Cote d'Ivoire, Nigeria	14	1.4	Automatic take-off, landing, and identification system
Akinci UCAV	Turkiye	Burkina Faso, Ethiopia, Libya, and Mali	6	21.6	Enhanced Autonomy with Artificial Intelligence: Fully Autonomous Flight Control and Triple Redundant Autopilot System with Semi-Autonomous Flight Modes Support
Aksungur UCAV	Turkiye	Chad	1	4	Automatic target recognition system
Anka UAV	Turkiye	Chad & Tunisia	7	21	Enhanced Autonomy with Artificial Intelligence for flight and navigation. Its flight can be pre-planned and altered during autonomous flight with an automatic take-off and landing capability
Bayraktar TB-2 UCAV	Turkiye	Burkina Faso, Djibouti, Ethiopia, Kenya, Libya, Mali, Morocco, Niger, & Togo	64	153.6	Fully autonomous taxiing, take-off, landing and cruise
CH-3 UCAV	China	Algeria & Nigeria	12	28.8	Fully Automatic Landing, Take-off and Operation
CH-4A UAV	China	Algeria	5	15	Equipped with autonomous flight capabilities, including waypoint navigation and automatic take-off and landing. Primarily remotely piloted with limited autonomous capabilities
CH-4B UCAV	China	DR Congo & Nigeria	13	52	Equipped with autonomous flight capabilities, including waypoint navigation and automatic take-off and landing. Primarily remotely piloted with limited autonomous capabilities
Hermes-450 UAV	Israel	Zambia	3	6	Automatic take-off and landing
Heron UAVs	France	Morocco	3	3.6	Fully automated mission system
ScanEagle UAV	United States	Cameroon & Kenya	4	1.6	Launches autonomously by a catapult launcher—no runway required—and is retrieved via a patented SkyHook recovery system
ThunderB UAVs	Israel	Morocco	10	0.8	Automatic take-off and landing, fully autonomous flight control system and an intuitive, mission-oriented ground control station (GCS) with small cargo capsules that can be released automatically or on command
Wing Loong-1 UCAV	China	Algeria, Egypt, Morocco, & Nigeria	19	66	Primarily remotely piloted but equipped with autonomous flight capabilities, such as waypoint navigation and automatic take-off and landing
WJ-700 UCAVs	China	Algeria	4	30	Designed for both remote operation and autonomous missions, including precision strikes and reconnaissance
			167	404.36	

Source: Designed by the authors with data on weapons sourced from SIPRI Arms transfers database (2025) and specification derived from multiple sources, including official websites of manufacturers, such as Baykartech, Boeing, China defense equipment Co., Limited, Elbit Systems Ltd, and Bluebird Aero System, as well as defence-related media such as Africa Defense Forum, Airforce Technology, Army Recognition, Defence Turkey, Defence Web, IAI, Military Africa, Military drones, Military Factory, Militarnyi, and many others.

Table 2. African acquisition and spending on weapons with autonomous features, 2000–2024.

Recipients	Numbers delivered	Total values of delivery (million $)	Designation	Suppliers
African Union	3	0.3	Aerostar UAV	Israel
Algeria	16	65	CH-4A UAV; CH-3, Wing Long-2, & WJ-700 UCAVs	China
Burkina Faso	10	22.8	Akinci & Bayraktar TB-2 UCAVs	Turkiye
Cameroon	2	0.08	ScanEagle UAV	United States
Chad	3	10	Aksungur & Anka UCAVs	Turkiye
Cote d'Ivoire	2	0.2	Aerostar UAV	Israel
Djibouti	2	4.8	Bayraktar TB-2 UCAV	Turkiye
DR Congo	9	36	CH-4B UCAV	China
Egypt	10	30	Wing Loong-1 UCAV	China
Ethiopia	5	14.1	Akinci & Bayraktar TB-2 UCAVs	Turkiye
Kenya	8	14.48	Bayraktar TB-2 UCAV & ScanEagle UAV	Turkiye, United States
Libya	13	33.3	Akinci & Bayraktar TB-2 UCAVs	Turkiye
Mali	7	21	Akinci & Bayraktar TB-2 UCAVs	Turkiye
Morocco	34	58	Heron & ThunderB UAVs; Bayraktar TB-2 & Wing Loong-2 UCAVs	China, France, Israel, & Turkiye
Niger	6	14.4	Bayraktar TB-2 UCAV	Turkiye
Nigeria	25	53.7	Aerostar UAV; CH-3, CH-4B, Wing Loong-1 UCAV	China, Israel, Turkiye
Sudan	2	0.4	Ababil-3 UCAV	Iran
Togo	2	4.8	Bayraktar TB-2 UCAV	Turkiye
Tunisia	5	15	Anka UAV	Turkiye
Zambia	3	6	Hermes-450 UAV	Israel
	167	404.36		

Source: Designed by the authors with data on weapons sourced from SIPRI Arms transfers database (2025) and specification derived from multiple sources, including official websites of manufacturers, such as Baykartech, Boeing, China defense equipment Co., Limited, Elbit Systems Ltd, and Bluebird Aero System, as well as defence-related media such as Africa Defense Forum, Airforce Technology, Army Recognition, Defence Turkey, Defence Web, IAI, Military Africa, Military drones, Military Factory, Militarnyi, and many others.

3, CH-4B, and Wing Loong-1 UCAVs. All these countries have been involved in counterinsurgency operations, where these platforms played some roles (Okpaleke et al., 2023; Oyewole, 2021). However, the platforms used, either manned or unmanned, and their level of autonomy have not received adequate attention in public and academic debates. In contrast, two cases of L/AWS (STM Kargu-2 and Triton) deployment, testing, and employment in Africa have received considerable public attention.

The first well-known case of LAWS deployment and employment in Africa happened in 2020, amidst Operation Peace Storm, which was launched by the Libyan GNA against rebel forces along the coastline. The UNSC (2021) reported that the GNA forces used Turkish-made STM Kargu-2 UCAVs and other loitering munitions to hunt down and remotely engage the retreating forces and the logistic convoys of General Khalifa Haftar. The platform used was recognized by the UN as LAWS, as it was "programmed to attack targets without requiring data connectivity between the operator and the munition: in effect, a true 'fire, forget and find' capability" (UNSC, 2021, 17). Although weapons with different levels of autonomy have been employed in Africa before this, it was a notable turning point with international public confirmation and acknowledgement of the use of LAWS in African conflicts.

STM Kargu-2 is a plate-sized quadcopter equipped with cameras, onboard AI, and a warhead of roughly 1 kg (Russell 2021). It's a product of the Turkish defense company STM, a loitering munition that leverages facial recognition with the capacity to attack targets without human control or supervision (STM, 2024; Turkish Defense News, 2024). Airforce Technology (2021) describes the STM Kargu-2 as "a 7 kg drone that measures 600 mm long, 600 mm wide, and 430 mm high. Kargu is equipped with Indigenous national embedded hardware and software, 10x optical zoom, built-in artificial intelligence (AI), two-axis stabilized Indigenous pod, and a user-friendly ground control unit interface." Meanwhile, Bode and Watts (2023, 17) describes STM Kargu-2 as "real-time image processing capabilities and machine learning algorithms to facilitate strikes against fixed and moving targets." Apparently, from these descriptions, the STM Kargu-2 has an autonomous version that utilizes machine learning for its operations.

A recent known instance of AWS on the African continent was the deployment, display and testing of the autonomous Triton surface/subsurface drone at the coast of Libreville, Gabon (West Africa) by the Commander, Task Force (CTF) 66 of the US Naval Forces Europe and Africa (NAVEUR-NAVAF) during the 2024 Exercise Obangame Express in the Gulf of Guinea (GoG) (Edy, 2024; Lionel, 2024a). Like Exercise Phoenix Express with the North African forces in the Mediterranean Sea and Exercise Cutlass Express with the East African coastal and Western Indian Ocean forces, Obangame Express is a multinational exercise that was designed to build the capacity of West African coastal states in maritime situation awareness and policing, especially in combating sea piracy, armed robbery, arms, drugs, and human trafficking, illegal, unreported and unregulated (IUU) fishing, and other maritime crimes. Although counter-piracy and other maritime security operations in the GoG have been dominated by regional players, such international support and capacity building are critical to the progress record (Oyewole, 2016). Amid these, the display of Triton surface/subsurface capabilities by the US Navy to their African counterparts in the GoG is noteworthy.

Triton drone has aerial, surface, and subsurface variants. The Naval Air Systems Command (2024) describes the Triton drone as a maritime intelligence, surveillance, and reconnaissance (ISR) capability using multiple maritime sensors for surface and underwater operations. The drone weighs about 775 pounds and measures 14½ feet in length, and "it is embedded with video line scanners, combined thermal imagery (SWIR), solid-state radars, passive mini-towed arrays, side-scan and gap-filler sonars, and many other sensors" (Kesteloo 2024; Lionel 2024a). It relies on onboard AI with machine learning and connectivity for real-time data transmission back to the on-ground team (Maxwell 2024). The US Navy also maintains an aerial variant of Triton, such as the MQ-4C Triton, that could operate for 24 hours within a range of 8,200 nm. It has a 360-degree view and uses software to autonomously track and gather information on ships within its area of capacity, which extends over a 2,000 nm radius (Sayler, 2016, 3). Triton generally provides a persistent, broad area maritime surveillance (BAMS) capability. From the available evidence, the Triton drone displayed and tested by the US Navy in West Africa was for ISR and not coercive purposes. However, a series of Ukrainian attacks against Russian naval fleets in the Black Sea shows that such sea drones can be converted into offensive weapons.

These two cases show the emerging realities of the acquisition, display, and utility of lethal and non-lethal AWS in Africa. The cases indicate the evolving trajectories of (surface, subsurface, and aerial) warfare, defence, and security in the age of AWS. They reflect the acquisition and use of such weapons by African states and foreign powers on the continent. Although foreign military bases, deployments, capabilities, exercises, and operations in Africa have gained considerable public and academic attention (IISS, 2018–2025; Olumba, 2025; Turse, 2015), the autonomous features of their assets remain shrouded in secrecy. For instance, the US maintains the MQ-9A Reaper in Djibouti (since 2017) and Niger (2019–2024) for its operations in the Horn of Africa and the Sahel (IISS, 2018–2025). The platform features fully autonomous capabilities and an Automated Identification System (AIS) (General Atomics, 2025). However, the platform's autonomous features and possible operations have not received adequate attention. On these bases, the next section examines the potential benefits of L/AWS in Africa.

Prospects and potential benefits of L/AWS in Africa

Existing African perspectives on AWS focused on the risks and threats they pose to humanity (Chengeta, 2016; Heyns, 2017), ignoring their relevance, benefits, and prospects. However, AWS holds considerable prospects, even in Africa. These include their potential to boost the capabilities of African states and militaries in ISR, force protection, frontline support, coercion, and precision, among others. These are considerable prospects for defence and security strategists in African countries that are faced with various threats, including state-centric regional tension, coup d'etat, and sub/*trans*-national campaigns of terror by armed bandits, illegal miners, insurgents, mercenaries, militants, pirates, robbers, smugglers, terrorists, and (arms, drugs, and human) traffickers. These are the obtainable security situations for many African countries. Accordingly, this section examines the prospects of adoption, deployment and employment of AWS for ISR, non-combat tactical roles, and combat roles on the continent.

AWS can boost the intelligence gathering, processing, analysis, and utilization of military and paramilitary forces for strategic and tactical purposes. Aerial, surface, and subsurface AWS are well-positioned for these purposes. Intelligence failure is in/directly responsible for many security challenges across Africa, including coup d'etat, criminality, insurgency, and terrorism. Over the last five years, Burkina Faso, Guinea, Mali, Niger and Sudan have become victims of the new wave of military coups in Africa (Akinola, 2024). Illegal fishing, mining, and refining of gold, diamond, oil, and other natural resources are increasing all over the continent. Boko Haram insurgents and armed bandits have recorded numerous devastating attacks against military targets and the civilian population in the Lake Chad region over the last decade (Ojo et al., 2024; Oriola et al., 2021). The recent Ethiopian Civil War (2020–2022) started with a series of surprise and successful attacks on the federal military Northern Command headquarters and bases by the rebellious regional forces, Tigray People's Liberation Front (TPLF) (Reuters, 2020). In July 2024, Malian military forces and their Russian mercenaries lost over one hundred men to surprise attacks by Tuareg rebels and Jama'at Nusrat al-Islam wal-Muslimin (an al-Qaeda affiliate in the Sahel) (Ojewale et al., 2024). These and many more are indicators of intelligence failure that undermined human, political, economic, maritime, and military security in Africa.

ISR-purposed AWS can access data from land, sea, air, space, and cyberspace domains, process them in a timely and effective manner, alert the appropriate command, and possibly recommend relevant and most efficient responses. Such a system can support the military police and civilian authority to monitor and prevent mutiny, while enhancing intelligence and protection of bases and personnel of armed forces of different African countries. Through timely gathering and effective processing of intelligence, the system can also aid rapid preparation and response to insurgent attacks, crimes, disasters, and other threats against the populations and infrastructures. In the frontline, especially in a jungle warfare, all domains-supported AWS can help troops to identify the targeted enemy's location and possible strength, guide the troop's movement toward the target, and provide landmine and other threat alerts to the advancing party. In urban warfare, such a system can provide an alert for any illegal or undocumented weapon possession, which may serve as early warning for assassination, armed robbery, (suicide) bombing, and vandalism. In these cases, AWS cannot be ignored even by African countries in the shadow of insecurity.

Beyond ISR in strategic and tactical contexts, AWS can provide other noncombatant services to military and paramilitary in operational theaters. Autonomous vehicles of different kinds can aid logistics by delivering supplies and possibly enable reinforcement and force insertion at the frontline. They can feature in first aid and emergency medical support, evacuation of deceased and wounded soldiers, as well as civilians trapped or abducted and rescued from the frontline. They would be relevant in evacuating people from areas threatened or affected by disasters, and in searching, rescuing, and relieving trapped civilians. This is important in Africa, where 3,792 cases of various disasters that affected 402,013,063 persons were recorded between January 2000 and July 2022 (Oyewole, 2022a). In addition to capacity in threat identification, AWS can provide timely, effective, safe, and environmentally friendly means to neutralize land and sea mines as well as (suicide) bombing in combat zones. AWS can intercept, disrupt, and disable the enemy's strategic and tactical communications and logistics. These capabilities cannot be ignored even by policymakers and strategists in Africa.

Although LAWS are the most controversial dimension of such capabilities, their prospects in deterrence and eliminating hostile targets without one's own force casualties cannot be ignored, even by African countries and forces. LAWS has the potential to change the military and strategic basis of attrition warfare by eliminating or at least minimizing casualties. For many African countries, such as Cameroon, Chad, Ethiopia, Libya, Mali, Mozambique, Niger, Nigeria, and Sudan that have lost thousands of soldiers to insurgents in recent years, LAWS adoption and deployment tend to present considerable opportunity to maintain relevant operational presence, tempo and performance with little or no force depletion. Moreover, LAWS have the potential to accurately identify and precisely neutralize targets with minimal or no unintended casualties and adverse environmental effects. As evident in recent cases of Ethiopia, Libya, Nigeria, and Sudan, the human and environmental costs of military campaigns in Africa are huge. For example, a study of 514 documented cases of airstrikes in Nigeria between 1997 and 2020 reveals that nine per cent of fatalities from targeted strikes are civilians (Oyewole, 2021). In these cases, L/AWS have the potential to eliminate or minimize human errors in intelligence gathering, processing, and analysis as well as operational decisions responsible for civilian casualties.

Beyond the military and strategic perspective, the prospects of AWS can also be deduced from political economy and military sociology perspectives. From these perspectives, AWS can help to reduce human resources required by the military and avoid conscription, even in times of war, especially for the less populated countries with fewer mobilization capacities. As of 2023, the population of 47 of the 54 African countries was below 50 million, while 21 of them had below 10 million, and four were below 1 million (World Bank, 2024). It is not surprising that active military personnel of some 20 African countries are 10,000 or fewer (IISS, 2018-2025). Understandably, AWS would make the loss of personnel unnecessary and less/un-likely for the military, saving their families and society from the loss of loved ones and closing the room for anxiety and bereavement. They also have the potential to cut the cost of war, as they minimize the required food at the frontline, salary for mobilization, deployment allowance, medical bills for the injured, and compensation to families of falling soldiers. Their precision targeting and strike could equally cut the waste of ammunition and cases of collateral deaths from unguided strikes. The potential benefits of AWS cannot be ignored by troubled African countries amid dwindling military budgets and the growing public campaigns for casualty aversion in combat.

Finally, from the realist perspective of International Relations, African countries cannot ignore AWS, considering how its adoption by some countries would amount to insecurity for others. Development, adoption, and/or deployment of L/AWS by Turkey, Israel, Iran, Libya, South Africa, Egypt, and others in the Middle East, Mediterranean, and Africa will cause ripple effects and pressure many other countries to follow this path. In addition to those with emerging production capacity, Tables 1 and 2 show that 19 African countries have acquired weapons with autonomous features in the last two decades. The struggle to acquire weapons with autonomous features has become a reality in Africa. On a positive note, this adds AWS to the credentials of African countries and their capabilities in defence, security, and power projection (Isike & Schoeman, 2023; Ogunnubi and Oyewole, 2020). Equally, advocates of independent research, development, and defence capabilities of African states suggest that ignoring emerging scientific and technological trends, including in military domain, such as AWS, would further widen the existing development gap between the continent and other regions of the world (Marwala, 2022; Olumba, 2025; Oyewole, 2023, 2024; Sooryamoorthy, 2024). These and other points are prospects and potential benefits of L/AWS for African countries. Nevertheless, the next section explores the possible risks of L/AWS in Africa.

The possible risks of L/AWS in Africa

Despite the considerations, prospects, and potential benefits of L/AWS, the risks cannot be ignored, even in Africa. Although African countries have increasingly acquired weapons with autonomous features, the capacity for research and development of L/AWS on the continent is limited to a few countries. The acquisition and development of AWS on the continent have been inspired by indigenous research and foreign technological transfer. However, with the current pace of research and development (R&D) in Africa, the continent is in a risky position in the emerging world of AWS. Extracted data from the World Bank (2024) shows that Sub-Saharan Africa only accounted for 26,502 resident patent applications, while the Middle East and North Africa accounted for 247,698 between 2000 and 2020. These amounted to 0.085 per cent and 0.796 per cent of the world total, respectively. Amidst these, Sub-Saharan Africa accounted for 0.12 per cent of granted AI patents, while the Middle East and North Africa accounted for 0.03 per cent between 2010 and 2020 (HAI, 2024). With limited indigenous R&D capacity, most African countries risk missing out or lagging behind the rest of the world and relying on foreign technologies in the age of AI and AWS.

Beyond the indigenous R&D path to adoption of AWS, technological transfer is an alternative path for many African countries. This is possible through production licensing, training and capacity building, foreign in/direct investment, procurement, reverse engineering, and aid. However, the tendency for any country to transfer its most advanced technologies, such as AWS, to another country, perhaps except a top-tier strategic partner, is debatable. Hence, African countries risk perpetual bottom positions in the emerging world of AWS with reliance on technological transfer. Moreover, the tendency to purchase or receive such weapons as an investment or aid from foreign powers can undermine the national security and sovereignty of the recipient countries. The supply of these military and dual-use technologies is controlled by the Wassenaar Arrangement and other arms control regimes.[3] Besides, the weapons could offer the suppliers unintended opportunities to monitor and possibly control African military operations, and further deepen the region's dependency on the suppliers with adverse military and geopolitical consequences.

The tendency for African countries to become testing grounds and operational theaters for the deployment and employment of L/AWS by foreign powers under the guise of international support, alliance, humanitarian intervention, responsibility to protect, global/multilateral war against terrorism, insurgency, trafficking, piracy, and other notable threats of non-state armed groups, as well as geopolitical competition and cold war are increasingly alarming possibilities and risks that are rooted in history (Olumba, 2025; Oyewole, 2022b). In recent years, the USA, France, the UK, and other Western powers have contended with China, Russia, India, Iran, and other emerging powers for resources and influence in Africa (Alden, 2022; Kepe et al., 2023). In some cases, as evident in the Sahel and Horn of Africa, these competitions for power have taken a military dimension, as some of these foreign powers are covertly or overtly involved in military deployment and operations on the continent (Olumba, 2025; Oyewole, 2023). Accordingly, most African conflict zones have become theaters of power politics among foreign military powers. These imply that many African countries and conflict theaters risk becoming testing grounds for AWS developed and in/directly deployed by foreign powers. Accordingly, Africa can become endangered, as suppliers of AWS view the conflicts across the region as opportunities to sell, test, and assess their inventions. Perhaps, this is the case with the GNA of Libya's acquisition and use of Turkish-made STM Kargu-2.

Adoption of AWS by African countries also risks erosion of democracy and threatens human freedom on the continent. Freedom House (2024) noted that 17 per cent of African countries with 7 per cent of the continent's population are free, 46 per cent of the countries with 43 per cent of the population are partly free, while 37 per cent of the countries with 50 per cent of the population are not free. As such, having L/AWS under the control of authoritarian regimes, where the line between civil and militant resistant groups means little to those in power, has the potential to undermine the challenging human rights profiles of some African countries. In this case, adding AWS to the ISR capabilities of such states may further erode privacy rights, and their lethal capabilities can endanger rights to life for intended and unintended non-combat targets. While LAWS could be designed and programmed to avoid unintended targets, their abilities to do justice in the face of orders to eliminate noncombatants are debatable.

Non-state armed groups can equally gain control of L/AWS, either by exploiting the cyber vulnerability of the assets or through military success against state actors. In some cases, insurgent forces have developed crude versions, reverse-engineered, clandestinely acquired, and deployed sophisticated weapons such as UAVs, missiles, and tanks (Okpaleke et al., 2023; Oriola et al., 2021). The US reportedly lost three MQ-9 Reaper UCAVs to the Yemenis Houthis in May 2024, and MQ-1 Predator UCAVs in Libya and Niger in November 2019 and February 2023, respectively, (Olumba et al., 2024). There are cases where the insurgents defeated state-owned military forces, and seized their assets in battle fronts, sometimes occupied their bases, and in extreme cases replaced the constituted state authority in control of territory and government. Such instances can be found to various degrees at different points in time in Burkina Faso, Cameroon, Chad, Ethiopia, Liberia, Libya, Mali, Niger, Nigeria, Somalia, and Sudan (Meredith, 2005; Oyewole and Amusan, 2020). Moreover, foreign military powers, such as the USA and France, have recently recorded some challenging operations in Africa and the Middle East, where some technologically advanced drones and other critical assets were lost in engagement with the rebels (Olumba et al., 2024). Therefore, the risk of AWS falling into the hands of non-state armed groups cannot be ignored in Africa.

Finally, there is a potential for a regional geopolitical dimension to the risk of L/AWS in Africa. Although the realities of the competition for power and the attendant conflicts among African states are often covered under the spirit of Pan-Africanist unity and brotherhood, some military assets, strategies and developments have inspired undisclosed and unintended arms race in the region (Isike & Schoeman, 2023; Ogunnubi and Oyewole, 2020; Oyewole, 2024). It is unlikely for L/AWS adoption in Africa to be an exception in fueling a covert or overt arms race in the region. As earlier identified, African countries are increasingly acquiring, adopting, developing, testing, and deploying AWS. Accordingly, the continent risks an undisclosed or open arms race of leading regional powers over AWS development, adoption, and deployment.

Conclusion

Extant literature on AWS has paid little or no attention to Africa, perhaps due to the limited capacity of most countries in the region in policy commitments, investment, development, and deployment of such capabilities. However, many African states have displayed interest in the AWS acquisition, development, adoption, deployment, and employment. It is on these bases that this article attempts to contribute to the literature on the subject by providing African experiences and perspectives on L/AWS, drawing insights from available details on the realities, prospects, and risks of such weapon development, adoption, testing, and deployment. Amid these, the article explores the role of foreign military powers, their involvement in the technological transfer and testing of AWS in Africa, and the possible benefits, opportunities, and risks for development and security in the region.

Prominent among the (potential) benefits of AWS in Africa is the prospect of getting the job done, that is, ISR and possibly neutralize the targets effectively with little or no unintended human and environmental cost, and without own force casualties. L/AWS have the prospects to increase target identification, weapon delivery, and kill precision in operational theater compared to manned platforms and semi or un-guided weapon systems. AWS could help to cut the human and financial cost of war, bridge the technological gap, and add to the power credentials of African countries. However, these countries risk their sovereignty, national security, and freedom to rely on technological transfer and adoption of foreign AWS, as well as technological lag and displacement for indigenous R&D in this area. They also risk erosion of their hard-earned democracy and human freedoms, and the potential of empowering non-state armed groups with AWS adoption. Against this background, this article advocates for a cost-benefit approach to AWS, and more policy and strategic-oriented research attention for the subject area, including in Africa.

Notes

1. In this article, we use AWS for autonomous weapons systems, LAWS for lethal autonomous weapons systems, and L/AWS for lethal or non-lethal autonomous weapons systems.
2. "The Gospel" generates lists of buildings or structural targets to be attacked, "Lavender" assigns ratings to people suspected to be affiliated with Hamas for military targets, and "Where's Daddy?" determines when a target is in a particular location so they can be attacked (Human Rights Watch, 2024).
3. https://www.wassenaar.org/; https://www.state.gov/bureau-of-international-security-and-nonproliferation/releases/2025/01/missile-technology-control-regime-mtcr-frequently-asked-questions/.

ORCID

Samuel Oyewole http://orcid.org/0000-0002-4685-1754

References

Abraham, Y. (2023). 'A mass assassination factory': Inside Israel's calculated bombing of Gaza. *+972 Magazine*. November 30. https://www.972mag.com/mass-assassination-factory-israel-calculated-bombing-gaza/

Abraham, Y. (2024). 'Lavender': The AI machine directing Israel's bombing spree in Gaza. *+972 Magazine*, April 3. https://www.972mag.com/lavender-ai-israeli-army-gaza/

African Defense Forum. (2025). *As drone warfare expands in Africa, Turkey increases share of the market*. February, 11, https://adf-magazine.com/2025/02/as-drone-warfare-expands-in-africa-turkey-increases-share-of-the-market/

Airforce Technology. (2021). *Kargu rotary-wing attack drone*, June 4. https://www.airforce-technology.com/projects/kargu-rotary-wing-attack-drone/

Akinola, A. O. (Ed.). (2024). *The resurgence of military coups and democratic relapse in Africa*. Palgrave Macmillan.

Alden, C. (2022). *Emerging powers and Africa: From development to geopolitics*. Istituto Affari Internazionali (IAI.).

Altmann, J., & Sauer, F. (2017). Autonomous weapon systems and strategic stability. *Survival*, *59*(5), 117–142. https://doi.org/10.1080/00396338.2017.1375263

Amoroso, D., & Tamburrini, G. (2021). In search of the "Human Element": International debates on regulating autonomous weapons systems. *The International Spectator*, *56*(1), 20–38. https://doi.org/10.1080/03932729.2020.1864995

Arredondas, M. (2024). Mohammed VI calls for the development of the Moroccan Armed Forces' capabilities. *Atalayr*, May, 16, https://www.atalayar.com/en/articulo/politics/mohammed-vi-calls-for-the-development-of-the-moroccan-armed-forces-capabilities/20240516123411200250.html

Ary, D., Jacob, L., Sorensen, C., & Walker, D. (2014). *Introduction to research in education* (9th ed.). Cengage Learning.

Austero, M., Lubang, A. F., Nepram, B., Savage, P. G., & Tanaka, K. (2020). *Artificial intelligence, emerging technology, and lethal autonomous weapons systems: Security, moral, and ethical perspectives in Asia*. Nonviolence International Southeast Asia.

Badell, D., & Schmitt, L. (2022). Contested views? Tracing European positions on lethal autonomous weapon systems. *European Security*, *31*(2), 242–261. https://doi.org/10.1080/09662839.2021.2007476

Blanchard, A., & Taddeo, M. (2022). Jus in bello necessity, the requirement of minimal force, and autonomous weapons systems. *Journal of Military Ethics*, *21*(3–4), 286–303. https://doi.org/10.1080/15027570.2022.2157952

Bode, I., & Watts, T. F. A. (2023). Loitering munitions and unpredictability: Autonomy in weapon systems and challenges to human control. https://portal.findresearcher.sdu.dk/files/231643063/Loitering_Munitions_Unpredictability_WEB.pdf

Brown, S. R. (2005). *Structural phenomenology: An empirically-based model of consciousness*. Peter Lang Publishing.

Chansoria, M. (2016). To ban or regulate autonomous weapons: An Indian Response. *Bulletin of the Atomic Scientists*, *72*(2), 120–121. https://doi.org/10.1080/00963402.2016.1145917

Chengeta, T. (2016). Dignity, Ubuntu, Humanity and autonomous weapon systems (AWS) debate: An African perspective. *Brazilian Journal of International Law*, *13*, 460–502. https://doi.org/10.5102/rdi.v13i2.4135

Coeckelbergh, M. (2019). Artificial intelligence: Some ethical issues and regulatory challenges. *Technology and Regulation*, *2019*, 31–34. https://doi.org/10.71265/a9yxhg88

DefenceWeb. (2025). Chinese UAVs finding a large market in Africa, January 8. https://www.defenceweb.co.za/aerospace/aerospace-aerospace/chinese-uavs-finding-a-large-market-in-africa/

Edy, C. (2024). *U.S. Naval Forces Europe-Africa and U.S. Sixth Fleet Standup All-Domain Task Force*. 22 May. https://www.navy.mil/Press-Office/News-Stories/Article/3784097/us-naval-forces-europe-africa-and-us-sixth-fleet-standup-all-domain-task-force/

Engelbrecht, L. (2007). *Did software kill soldiers?* ITWEB. https://www.itweb.co.za/article/did-software-kill-soldiers/KPNG878X63l74mwD

Ferl, A. (2024). Imagining meaningful human control: Autonomous weapons and the (de-) legitimisation of future warfare. *Global Society*, *38*(1), 139–155. https://doi.org/10.1080/13600826.2023.2233004

Flinders, M., & Smalley, I. (2024). *What is AI infrastructure?* IMB, June 3. https://www.ibm.com/think/topics/ai-infrastructure#:~:text=AI%20infrastructure%20utilizes%20the%20latest%20high%2Dperformance%20computing,the%20ML%20algorithms%20that%20underpin%20AI%20capabilities.&text=Well%2Ddesigned%20AI%20infrastructure%20often%20includes%20specialized%20hardware,parallel%20processing%20capabilities%20and%20speed%20ML%20tasks

Freedom House. (2024). *Freedom in the World 2024*. Freedom House.

Galliott, J., & Wyatt, A. (2022). Considering the importance of autonomous weapon system design factors to future military leaders. *Australian Journal of International Affairs*, *76*(2), 219–244. https://doi.org/10.1080/10357718.2021.1940093

General Atomics. (2025). *MQ-9A "Reaper"*. https://www.ga-asi.com/remotely-piloted-aircraft/mq-9a

Gillespie, T. (2020). Good practice for the development of autonomous weapons: Ensuring the art of the acceptable, not the art of the possible. *The RUSI Journal*, *165*(5–6), 58–67. https://doi.org/10.1080/03071847.2020.1865112

Guha, M., & Galliott, J. (2023). Autonomous systems and moral de-skilling: Beyond good and evil in the emergent battlespaces of the twenty-first century. *Journal of Military Ethics*, *22*(1), 51–71. https://doi.org/10.1080/15027570.2023.2232623

Haas, M. C., & Fischer, S. C. (2017). The evolution of targeted killing practices: Autonomous weapons, future conflict, and the international order. *Contemporary Security Policy*, *38*(2), 281–306. https://doi.org/10.1080/13523260.2017.1336407

HAI. (2024). Artificial Intelligence Index Report 2024. Human-Centered Artificial Intelligence (HAI). Stanford University.

Hespress. (2023). Morocco plans to incorporate AI in military gear for air and ground surveillance, Hespress English. *Morocco News*, December 13. https://en.hespress.com/76311-germany-reiterates-position-on-sahara-issue-as-expressed-in-joint-declaration-of-aug-25-2022.html

Hespress. (2024). *Morocco has second largest fleet of military drones in Africa*. Hespress—English, December 2024. https://en.hespress.com/99490-morocco-has-second-largest-fleet-of-military-drones-in-africa.html

Heyns, C. (2017). Autonomous weapons in armed conflict and the right to a dignified life: An African perspective. *South African Journal on Human Rights*, *33*(1), 46–71. https://doi.org/10.1080/02587203.2017.1303903

Hoffman, R. R., Cullen, T. M., & Hawley, J. K. (2016). The myths and costs of autonomous weapon systems. *Bulletin of the Atomic Scientists*, *72*(4), 247–255. https://doi.org/10.1080/00963402.2016.1194619

Human Rights Watch. (2024). Questions and answers: Israeli military's use of digital tools in Gaza. September, 10. https://www.hrw.org/news/2024/09/10/questions-and-answers-israeli-militarys-use-digital-tools-gaza

IISS. (2018–2025). *Military balance 2018-2025*. The International Institute for Strategic Studies (IISS).

Isike, C., & Schoeman, M. (2023). Group hegemonic leadership as an analytical framework for understanding regional hegemony in Africa. *African and Asian Studies*, *22*(1–2), 8–38. https://doi.org/10.1163/15692108-12341579

Iwan, D. (2022). Is transparency excluded where autonomous weapons systems are concerned? *Democracy and Security*, *18*(3), 203–227. https://doi.org/10.1080/17419166.2021.2016403

Jones, E. (2018). A posthuman-xenofeminist analysis of the discourse on autonomous weapons systems and other killing machines. *Australian Feminist Law Journal*, *44*(1), 93–118. https://doi.org/10.1080/13200968.2018.1465333

Kepe, M., Treyger, E., Curriden, C., Cohen, R. S., Klein, K., Rhoades, A. L., Schuh, E., & Vest, N. (2023). *Great-power competition and conflict in Africa*. RAND Corporation.

Kesteloo, H. (2024). Innovative naval drone TRITON demonstrates versatility in West African Waters. DroneXL. https://dronexl.co/2024/05/11/naval-drone-triton-west-african-waters/

King, A. (2024). Robot wars: Autonomous drone swarms and the battlefield of the future. *Journal of Strategic Studies*, *47*(2), 185–213. https://doi.org/10.1080/01402390.2024.2302585

Kohn, S., Cohen, M., Johnson, A., Terman, M., Weltman, G., & Lyons, J. (2024). Supporting ethical decision-making for lethal autonomous weapons. *Journal of Military Ethics*, *23*(1), 12–31. https://doi.org/10.1080/15027570.2024.2366094

Krygier, J., Lubkowski, P., Maslanka, K., Dobrowolski, A. P., Mrozek, T., Znaniecki, W., & Oskwarek, P. (2024). Smart medical evacuation support system for the military. *Sensors*, *24*(14), 4581. https://doi.org/10.3390/s24144581

Limata, T. (2023). Decision making in killer robots is not bias free. *Journal of Military Ethics*, *22*(2), 118–128. https://doi.org/10.1080/15027570.2023.2286044

Lionel, E. (2023). *Artificial Intelligence to enhance Nigerian Navy's operational capacity, Military Africa*. September 27, 2023. https://www.military.africa/2023/09/artificial-intelligence-to-enhance-nigerian-navys-operational-capacity/#:∼:text=The%20Nigerian%20Navy%20is%20embarking,competitive%20edge%20on%20the%20seas

Lionel, E. (2024a). U.S. Navy tests autonomous TRITON drone in West Africa to combat piracy and illegal activities. *Military Africa*. https://www.military.africa/2024/05/u-s-navy-tests-autonomous-triton-drone-in-west-africa-to-combat-piracy-and-illegal-activities/#google_vignette

Lionel, E. (2024b). *Nigerian Army determined to adopt "Smart Soldier" concept*, Military Africa, September 16. https://www.military.africa/2024/09/nigerian-army-determined-to-adopt-smart-soldier-concept/

Lionel, E. (2024c). TerraHaptix opens Africa's largest drone factory, Military Africa. February, 5. https://www.military.africa/2024/02/terrahaptix-opens-africas-largest-drone-factory/

Marwala, T. (2022). *Closing the gap: The fourth industrial revolution in Africa*. Pan Macmillan South Africa.

Maxwell, A. (2024). The Triton Aircraft quickly makes sense of a mysterious sea. Now Power by Northrop Grumman. https://now.northropgrumman.com/the-triton-aircraft-quickly-makes-sense-of-a-mysterious-sea

Melese, F., Richter, A., & Solomon, B. (2015). *Military cost-benefit analysis*. Taylor & Francis.

Meredith, M. (2005). *The state of Africa: A history of fifty years of independence*. Simon & Schuster UK Ltd.

Milkor. (2025). *Air*. https://milkor.com/air-system/

NAF. (2023). *CAS underscores significance of artificial intelligence*, Emerging Technologies in Naf Operations, 8 November, 2023. https://airforce.mil.ng/news/cas-underscores-significance-of-artificial-intelligence-emerging-technologies-in-naf-operations1414723302

Naval Air Systems Command. (2024). *MQ-4C Triton*. https://www.navair.navy.mil/product/MQ-4C

Ogunnubi, O., & Oyewole, S. (Eds.). (2020). *Power politics in Africa: Nigeria and South Africa in comparative perspective*. Cambridge Scholar.

Ojewale, O., Onuoha, F. C., & Oyewole, S. (2024). Mali is still unsafe under the military: why it hasn't made progress against rebels and terrorists. *The Conversation*, August 8.

Ojo, J.S., Aina, F., & Oyewole, S. (Eds.). (2024). *Armed Banditry in Nigeria: Evolution, dynamics and trajectories*. Palgrave Macmillan.

Okpaleke, F. N., Nwosu, B. U., Okoli, C. R., & Olumba, E. E. (2023). The case for drones in counter-insurgency operations in West African Sahel. *African Security Review*, *32*(4), 351–367. https://doi.org/10.1080/10246029.2023.2217158

Olumba, E. E. (2025). The necropolitics of drone bases and use in the African context. *Critical Studies on Terrorism*, *18*(1), 139–161. https://doi.org/10.1080/17539153.2024.2379642

Olumba, E. E., Oyewole, S., & Onazi Oche, T. O. (2024). "Killer robots" are becoming a real threat in Africa. The Conversation, 27 August, 2024. https://theconversation.com/killer-robots-are-becoming-a-real-threat-in-africa-233727

Omohundro, S. (2014). Autonomous technology and the greater human good. *Journal of Experimental & Theoretical Artificial Intelligence*, *26*(3), 303–315. https://doi.org/10.1080/0952813X.2014.895111

Omotola, J. S., Olaniyan, A., Aleyomi, M. B., & Oyewole, S. (Eds.). (2023). *Introduction to political science: A reading text on politics and governance*. Federal University Oye-Ekiti.

Oriola, T. B, Onuoha, F. C. and Oyewole, S. (Eds.). (2021). *Boko Haram's campaign of terror in Nigeria: Contexts, dimensions and emerging trajectories*. Routledge.

Oyewole, S. (2016). Suppressing Maritime Piracy in the Gulf of Guinea: The prospects and challenges of the regional players. *Australian Journal of Maritime & Ocean Affairs*, *8*(2), 132–146. https://doi.org/10.1080/18366503.2016.1217377

Oyewole, S. (2021). Struck and killed in Nigerian Air Force's Campaigns: Assessment of air strike locations, targets and impacts in internal security operations. *African Security Review*, *30*(1), 24–47. https://doi.org/10.1080/10246029.2020.1859394

Oyewole, S. (2022). Air and space strategies in African disaster management. Public lecture, the Royal Air Force (RAF) Museum. August 11th.

Oyewole, S. (2022b). *Meanings and memories of foreign airpower in Africa: Reflections on fears, humiliations and hope from the sky* [Paper presentation]. Presentation at the RAF Museum Conference on 'Meaning, Memory and the (Mis-) Remembered Past, September 6th.

Oyewole, S. (2023). Drone revolution in military airpower: African experiences and perspectives. In *Presentation at the RAF Museum's conference on "Progress, Regress, and Change: Air Force since the early 20th Century."* The UK. September 6th.

Oyewole, S. (2024). Military space strategies and African Realism: Egypt, South Africa and Nigeria. In S. M. Pekkanen & P. J. Blount (Eds.), *Oxford handbook of space security*. Oxford University Press.

Oyewole, S., & Amusan, L. (2020). Organised campaigns of terror: Terrorism in militant resistance and the responses of state security operatives in Africa. In L. Amusan & A. Badmus (Eds.), *Political instability in Africa* (pp. 109–135). Academic Press.

Prem, B. (2022). Governing through anticipatory norms: How unidir constructs knowledge about autonomous weapons systems. *Global Society*, *36*(2), 261–280. https://doi.org/10.1080/13600826.2021.2021149

Reuters. (2020). Inside a military base in Ethiopia's Tigray: soldiers decry betrayal by former comrades. December 17, 2020.

Riesen, E. (2022). The moral case for the development and use of autonomous weapon systems. *Journal of Military Ethics*, *21*(2), 132–150. https://doi.org/10.1080/15027570.2022.2124022

Rosendorf, O., Smetana, M., & Vranka, M. (2024). Algorithmic aversion? Experimental evidence on the elasticity of public attitudes to "Killer Robots." *Security Studies*, *33*(1), 115–145. https://doi.org/10.1080/09636412.2023.2250259

Russell, S. (2021). Ban autonomous killer robots before they become a threat. *Financial Times*, 6 August. https://www.ft.com/content/04a07148-d963-4886-83f6-fcaf4889172f

Russell, S. (2023). AI weapons: Russia's war in Ukraine shows why the world must enact a ban. *Nature*, *614*(7949), 620–623. https://doi.org/10.1038/d41586-023-00511-5

SAAIA. (2024). Defence Artificial Intelligence Research Unit (DAIRU) opens in South Africa, South African Artificial Intelligence Association. May 6, 2024. https://saaiassociation.co.za/defence-artificial-intelligence-research-unit-dairu-opens-in-south-africa/#:~:text=The%20establishment%20of%20the%20Defence,response%20to%20socio%2Deconomic%20challenges

Samir, M. (2024). Egyptian company unveils locally-made drones, smart munitions. *Daily News* Egypt, September 7. https://www.dailynewsegypt.com/2024/09/07/egyptian-company-unveils-locally-made-drones-smart-munitions/#:~:text=The%20company's%20flagship%20product%2C%20the,Defence%20Expo%20(EDEX%202023)

Santos, P. E. (2016). To ban or regulate autonomous weapons: A Brazilian Response. *Bulletin of the Atomic Scientists*, *72*(2), 117–119. https://doi.org/10.1080/00963402.2016.1145913

Sayler, K. (2016). The promise of unmanned systems in the Asia-Pacific. *Center for a New American Security*.

Shachtman, N. (2007). Robot Cannon kills 9, wounds 14, wired. https://www.wired.com/2007/10/robot-cannon-ki/

Simonite, T. (2007). "Robotic rampage" unlikely reason for deaths. *New Scientist*, *194*(2600), 26. https://doi.org/10.1016/S0262-4079(07)60998-1

SIPRI Arms Transfers Database. (2025). https://armstransfers.sipri.org/ArmsTransfer/TransferRegister

Sooryamoorthy, R. (2024). *Independent Africa, dependent science*. Palgrave Macmillan.

STM. (2024). *Kargu autonomous tactical multi-rotor attack UAV*. https://www.stm.com.tr/en/kargu-autonomous-tactical-multi-rotor-attack-uav

Taddeo, M., & Blanchard, A. (2022). A comparative analysis of the definitions of autonomous weapons systems. *Science and Engineering Ethics*, *28*(5), 37. https://doi.org/10.1007/s11948-022-00392-3

Turkish Defense News. (2024). KARGU Rotary Wing Loitering Munition System. *Turkish Defense News*. https://www.turkishdefencenews.com/kargu-rotary-wing-attack-drone/

Turse, N. (2015). *Tomorrow's battlefield: US proxy wars and secret ops in Africa*. Haymarket Books.

Udoh, G. (2024). Artificial intelligence and the future of armed conflicts: Contextualising Africa in the global matrix. In K. Roy (Ed.), *Artificial intelligence, ethics and the future of warfare: Global perspectives* (pp. 251–271). Routledge India. https://doi.org/10.4324/9781003421849-12

United Nations Office for Disarmament Affairs. (2023). *Lethal Autonomous Weapon Systems (LAWS)*. https://disarmament.unoda.org/the-convention-on-certain-conventional-weapons/background-on-laws-in-the-ccw/

UNSC. (2021). *Letter dated 8 March 2021 from the Panel of Experts on Libya established pursuant to resolution 1973 (2011) addressed to the President of the Security Council. S/2021/229*. https://documents.un.org/doc/undoc/gen/n21/037/72/pdf/n2103772.pdf

Warren, A., & Hillas, A. (2020). Friend or frenemy? The role of trust in human–machine teaming and lethal autonomous weapons systems. *Small Wars & Insurgencies*, *31*(4), 822–850. https://doi.org/10.1080/09592318.2020.1743485

Wingrin, D. (2024). Military Academy launches centre for artificial intelligence excellence. Defence Web, May 6. https://www.defenceweb.co.za/featured/military-academy-launches-centre-for-artificial-intelligence-excellence/

Wingrin, D. (2024). Milkor 380 UAV ushers in a new era for South African aerospace and defence capabilities. DefenceWeb, September 24. https://www.defenceweb.co.za/aerospace/aerospace-aerospace/milkor-380-uav-ushers-in-a-new-era-for-south-african-aerospace-and-defence-capabilities/

Wood, N. G. (2023). Autonomous weapon systems: A clarification. *Journal of Military Ethics*, *22*(1), 18–32. https://doi.org/10.1080/15027570.2023.2214402

World Bank. (2024). *World development indicators*. https://databank.worldbank.org/source/world-development-indicators

Wyatt, A. (2020). Charting great power progress toward a lethal autonomous weapon system demonstration point. *Defence Studies*, *20*(1), 1–20. https://doi.org/10.1080/14702436.2019.1698956

Wyatt, A. (2021). A Southeast Asian perspective on the impact of increasingly autonomous systems on subnational relations of power. *Defence Studies*, *21*(3), 271–291. https://doi.org/10.1080/14702436.2021.1908136