Autonomous Weapons Systems Guided by Agentic AI: Lessons for Morocco's Security and Defense

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Abstract:

In this research, we aim to explore the implication of Autonomous Weapon Systems (AWS) within the context of Moroccan security and defense. To achieve this, we analyze the ethical and strategic dimensions associated with the integration of these systems. While AWS present certain advantages and potential benefits, their adoption could also undermine Morocco's regulatory and technological governance frameworks, thereby increasing risks to national security and defense. Our approach includes a comprehensive literature review, a comparative analysis of notable international cases, and a detailed examination of key documents. Based on this analysis, we seek to provide clear guidelines and practical recommendations to support the responsible integration of AWS into Morocco's security and defense infrastructure.

Keywords:

1 Introduction

Artificial intelligence (AI) technologies, given the revolution they have marked in everyday life applications, including sensitive areas such as defense and national security, are also beginning to be involved in the processes of conducting modern wars and conflicts. AI systems and weapons used in unstable environments and unsafe areas are often known as systems capable of selecting targets and engaging without human intervention and autonomously. These weapons and computer systems not only present opportunities for time management, funding, efficiency, etc., for their users and the actors who employ them, but also potential risks and undesirable impacts at multiple levels. The adoption and use of such weapons, still under discussion in elite international arenas of debate and analysis, risk raising ethical, legal, as well as geopolitical and

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strategic questions, especially for states experiencing fragile internal situations or those in hostile or conflict-prone environments.

Morocco, as a state facing geopolitical challenges and still embroiled in territorial disputes, risks undermining its external image as a country supporting peace and regional stability, with the adoption and operational deployment of these weapons AWS in its national defense strategy.

While autonomous weapons offer significant operational advantages – such as increased precision, reduced human casualties, rapid execution of orders, improved efficiency in military operations, and cost saving – they also present serious risks. In contexts where human resources are limited, these systems can fill critical gaps on the ground. However, their strengths may also become liabilities, potentially threatening internal security and stability. Despite the many benefits of deploying AWS in sensitive state operations, this does not justify overlooking the complex questions and challenges they raise across multiple domains. Ethically, delegating lethal decision-making to machines poses serious moral concerns and undermines the central role of human conscience in warfare and conflict situations.

Moreover, the foundations of humanitarian law and the law of war will be at risk due to the unconsidered adoption of this technology, where the machines used bear no responsibility towards humans, and their algorithms can neither respect rights nor obligations, and their activities no longer hold their States or actors who use them accountable to the international community [1]. These gaps are widening due to the continuous deployment of agentic AI, where these computer systems can make decisions in operational spaces and sensitive events without resorting to central, regional, or even local commands, which can also impose unforeseen consequences by steering events towards escalation and confrontation [2].

Morocco, as a country operating in a sensitive context, must be aware of the potential impact of integrating such weapons on the geopolitical and security environment in North Africa, as well as in the Moroccan Western Sahara region. The region is plunged into a troubling period where diplomatic and security dynamics have increased instability and doubled security challenges in the region instead of contributing to the stabilization of inter-state relations in this area [3].

In these geopolitical climate – marked by declining diplomatic cooperation and strategic rivalries between neighboring states – the use of AWS technologies could reshape Morocco's security landscape. These systems offer potential advantages in enhancing border control and neutralizing threats, thereby strengthening the country's strategic position.

However, this could impose strategic changes and alter the balance of power, peace, and stability in the region. In this context, we believe we can find a national framework to develop the advantages of AWS, while marginalizing the impacts and undesirable effects during the deployment of these weapons and systems, which provoke geopolitical tensions and pressures against internal and regional peace and security. Moreover, the development of national industry capabilities in this field presents itself as a necessity to lay the foundations for solid territorial security and responsible and respectable technological sovereignty, particularly concerning hardware and software in the field of AWS. However, we believe that this process can only be accomplished with the presence of solid and relevant legal frameworks aimed at ensuring alignment and compliance, including complementarity, between national security efforts and international initiatives in the field of autonomous weapons responsibility and their use [4].

In our article, we aim to examine the implications of Autonomous Weapon Systems (AWS) for Morocco's national security, based on the analysis of their benefits in three areas of application, such as border applications, counter-terrorism, and maritime surveillance. Next, the ethical and legal challenges of integrating this technology and its potential impacts on regional and international stability. Finally, we are engaged in a process of analyzing the dimensions of these implications in order to ultimately provide a thorough understanding that will help us in the future to avoid the undesirable impacts of this technology and the risks imposed by these autonomous systems and to navigate them with full responsibility.

For the success of this task, we will mobilize unprecedented qualitative methodological potentials based on the exploration and study of documents related to the research question, concise and rigorous, which we hope will help us contribute to the process of rethinking the imbalanced situation. In this section, we will initially engage in theoretical discussions framing international life before the massive integration of AWS, then we will test this philosophical heritage in light of the complexity of AWS implications, and finally analyze the resulting projections according to the Moroccan context.

We find the challenges surrounding AWS deeply concerning, particularly ethical issues such as the dehumanization of war and the weakening of international accountability mechanisms, which raise critical questions about the effectiveness of these systems. In addition of the inability of international frameworks to keep pace with technological innovation [5], serves as a wake-up call for Moroccan decision-makers to engage in specific processes aimed at strengthening and consolidating national legal frameworks related to the regulation of the use and deployment of activities associated with these technologies deployed on national territory.

However, this will only be achievable with a parallel commitment to international cooperation and collaboration, strengthening the applicability of conflict law and promoting the presence of regulations limiting the undesirable uses of the technologies in question in our study in conflict and war zones [6]. Morocco should introduce a national security strategy into its production processes for this type of weapons and armaments, involving policymakers, military strategists, technologists, and ethicists to produce an objective policy and concise recommendations that meet the requirements and challenges while preserving national security.

2   Background and Literature Review

2.1 The Historical Context

The development process of these autonomous systems is the accumulation of a very long technological and technical development process, ranging from the first remote control systems to the complex machines of semi-autonomous and autonomous systems. According to Pacholska (2022) [7], these systems only emerged after a long period of use, or in other words, thanks to the experience and integration into the drone systems that we specifically know today. She adds that the development of these weapons and systems is the result of a long process of innovation and military support, especially scientific and financial. That is why she noted that various military equipment has already been operating remotely for many years, which we can now qualify as systems incorporating a high degree of autonomy in decision-making.

This evolutionary process is confirmed by Sauer (2021) [8], adding that, in addition to generous funding that stimulates innovation and regulatory debates, the search for efficiency and performance of technological equipment, particularly used in direct military activities or in experiments, is also the origin of the desire to develop such operational systems advantageous both strategically and on the battlefield. For this reason, we can say as it is shown in Fig. 1., that the origins of AWS, are a reflection of direct military contribution, and research defense laboratories.
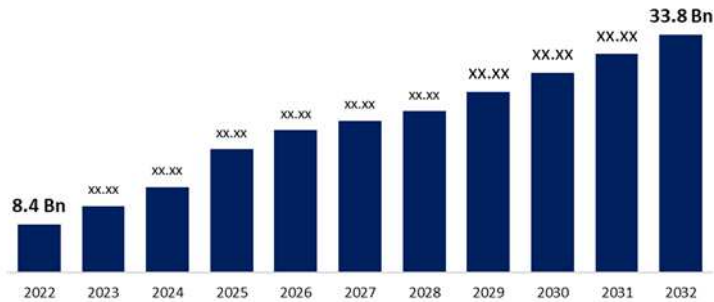

Fig. 1 Global AI, in military market size to worth USD 33.8 billion *by* 2032 [9]

2.2 The Context of Technological Development

The general process of developing artificial intelligence and machine learning technologies through its various pathways has been a key element for the design of AWS with their autonomy and precision capabilities. According to Liddell (2024) [10], the results of this success in technical and technological accumulation are impressive, as the systems in question have managed to make their own decisions, identify their goals, and execute their actions with minimal human intervention.

However, other ideas have accompanied this process in addition to those primarily aimed at reducing human tastes for war, paving the way for potential misuse, such as the development of killer robots and replica systems that maneuver in sensitive defense areas completely autonomously.

These developed systems and weapons are not limited in terms of activities to micro-use systems and weapons such as small control or offensive drones, or the category of firearms in border areas. However, we have noticed that AWS have invaded the domain of large armed vehicles and military cargo, including armored vehicles operating on land, naval warships, and autonomous systems for countering online misinformation [11]. This has complicated the situation with other questions surrounding autonomous systems combined with the potentials of AI, which are not yet addressed with sufficient depth and are far from traditional frameworks in analysis and study.

2.3 The International Jurisdictions and Ethical Requirements

These systems, designed with their potential for autonomous decision-making and targeting, challenge international legal norms, particularly those related to the regulatory frameworks of the law of war and humanitarian and peace operations. International law experts are currently questioning the effectiveness and relevance of these norms in light of the technological innovation known as autonomous decision-making and targeting systems, and doubt the ability of these rules to limit their negative effects on

accountability and compliance with known rules in the face of this unprecedented technological innovation [12].

Military activities, for example, based on the use of AWS can no longer hold the user responsible when the rules of Jus ad Bellum do not recognize AWS as responsible actors of war before the international community, and do not yet interpret them as independent instruments outside the traditional category of weapons [13].

In addition to the legal challenges, Renik and Schwars (2023) [14], confirm that the issues of dehumanization of war also raise numerous questions and inquiries, further complicating efforts for an international law on autonomous systems combined with the potential of AI. This means that we are faced with a complicated sentiment that will change warfare in the future by raising the question of how a soldier will morally accept fighting machines or being killed or captured as a war hostage by machines, etc. The international community still seems divided on these issues, as technological innovations are developing exponentially, making the need for international legal instruments and mechanisms to regulate this field and ensure the rights and respect for humanitarian and operational requirements paramount [15].

2.4 The Security Dimension of AWS

Allowing the integration of AWS into national security strategies will offer us unprecedented potentials in terms of optimizing financial costs and reducing risks, efficiency in border control and surveillance operations, cyber control, strategic superiority, and reducing human losses in conflict zones and hostile environments, etc. [16]. However, Cools and Maathuis (2024) [17], argue that this deployment, in the absence of organizational and management standards, can cause geopolitical and strategic disruptions and large-scale transformations in the international system. This is confirmed by the recent use of an exceptional American naval warship, fully autonomous, armed, and guided by artificial intelligence, directed against China's maritime ambitions in the Taiwan Strait, as stated by some researchers [18].

And in another example, the two Koreas have fortified their borders with autonomous light weapons guided by artificial intelligence as it is demonstrated in Fig. 2, in order to effectively control and monitor their borders. However, and for the same reasons, blind trust in the capabilities of these weapons and systems can lead to unimaginable disadvantages in case of errors.

The concerns of these researchers stem from several possibilities, the most significant being a scenario in which this advanced technology falls into the hands of criminal actors capable of exploiting its potential [20], as shown in Fig. 3, or an irresponsible state adversary that could threaten the interests of its neighbors.

On the one hand, this situation of void and gap regarding the effective management and regulation of this technology risks, imposes further challenges to international security already subjected to several geopolitical pressures, and on the other hand, it underscores the importance of inaugurating a specific process of cooperation and collaboration to address the issues imposed by this technology on global security and stability [22].

2.5 Decision-Making by AI Agent Systems

As Taddeo (2024) has argued, it seems that we face a fundamental dilemma, which is the balance between the decision-making potential of autonomous systems and the historical human dependence on decisions regarding such causes and events [23]. The

systems under discussion challenge and compete with human will and consciousness by balancing individual capabilities in terms of responsibility and morality with machine decisions, even in the case of unfavorable outcomes. However, Amoroso and Tamburrini (2020) [24], sought to balance this philosophical discussion by asserting that the debate continues around the balancing capabilities of these systems, prioritizing human control and considering that human presence remains essential to ensure compliance, ethics, and the prevention of technical abuses.
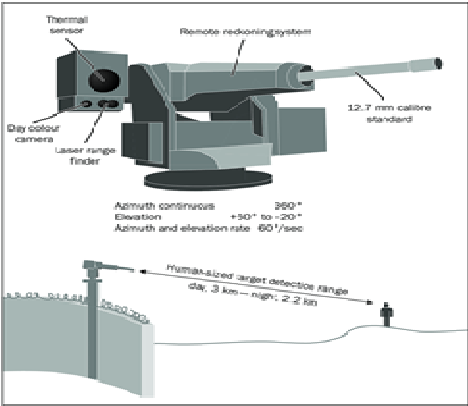

Fig. 2 Super aEgis II: South Korean-made sentry gun system [19]

Fig. 3 Applications of artificial intelligence in defense sector [21]

In this competitive sense of the debate, a balance movement has emerged, attempting to promote a path considered necessary to balance this power play between machines and humans. This movement, based on the literary accumulations alarming humanity about the threats of artificial intelligence and the probabilities of dangers and

risks stemming from this technology, attempts to take the initiative out of the hands of machines and humans and direct the debate towards the levels of autonomy that directly impact responsibility and ethics within operations [25]. Hence, we can say that this technology has truly impacted military operations, as well as its legal, ethical, and strategic implications. However, efforts in the literature and international collaboration assert that we are facing attempts to develop standards and fill the gaps to address multifaceted challenges.

3   Suggested Theoretical Framework

In our study, we will use a multidisciplinary paradigm that combines several ideas in order to achieve the goal of understanding the issues and challenges of the implications of introducing autonomous systems into human decision-making processes, according to the requirements of the Moroccan context. In this regard, we have mobilized the theoretical potentials of objective war theory, the concepts of AI and ethics, as well as the potentials of analysis in international relations, which we hope will all help us demystify the fog surrounding the implications of these discussion systems in a military context and large-scale conflicts.

3.1 Use of Objective War Theory

This theory offers us the potential for respectful analyses thanks to its previous contributions to the analysis and evaluation of issues related to technologies introduced in the processes of war, confrontation, and conflict. This theory, based on principles and requirements imposing the existence of clear objectives for waging war, stipulates the obligation of the presence of success such that we can no longer go to war if we are no longer sure of winning. Moreover, resorting to war according to the criteria of this theory of clear objectives means that we can only engage in it when all diplomatic and political possibilities have been exhausted. Finally, resorting to war in the objective theory should constitute a logical cause and never a means to defend irrationality and immorality [26]. In this section, we will use the well-known theory in the field of Jus ad Bellum to analyze, evaluate, and examine the potentials of these systems in times of war and peace.

We can preliminarily observe that these weapons and systems in no way comply with or meet the conditions or requirements set forth by the aforementioned theory. AWS are not political entities; they never possess the political will to declare war, and they never guarantee the definitive success of their operations. Furthermore, the AWS cannot, under any circumstances, interpret the exhaustion of probabilities and the recourse to war as a last resort. Finally, will the AWS have all the analytical and interpretative potential to judge such a situation of resorting to force as a logical, rational, and moral situation to be deployed in the territorial border areas of Morocco?

In addition to the previous principles, the theory also contains two main principles. The distinction and proportionality, each of which constitute requirements and principles for conducting war and organizing the use of violence. The first defines the obligation for combatants to distinguish between civilians and combatants in field operations, while the second constitutes that destruction and damage caused to civilians during war or intervention must never exceed the direct military advantages.

In this analytical context, Yilmaz (2023) [25] argues that discussions reveal that these systems indeed present challenges – especially in the Moroccan context – regarding discrimination and proportionality, where the lack of supervision and intervention

and human interpretation in the decision-making processes of these systems raises concerns about their incapacity and the difficulties in understanding the distinction between combatants and non-combatants as principles for evaluating this theory.

Zając (2023) [26], within the framework of the theory of objectives, examines how the use of the AWS, can violate the principle of proportionality – particularly in scenarios involving potential destruction in civilian areas or zones with high population density. The principle of proportionality requires combatants to distinguish between civilians and legitimate military or strategic targets, as recognized under international humanitarian law. Zając Concludes that, in most of the cases studies, AWS are often incapable of reliably distinguishing between civilian objects and military assets, including mobile or displaced materials intended to support war efforts. Additional studies have also explored the broader impact of AWS on military operations, focusing on violations of legal and international norms governing the conduct of war. These critiques emphasize not only the dangers of automating human decision-making in high-stakes situations but also the urgent need to ensure that the development and deployment of AWS align with ethical principles grounded in law, morality, and policy [27].

3.2 Exploration of Ethical Principles

Regarding ethics, even in cases of conflicts or overlaps between state actors, humans always prefer transparency of activities and fairness in human supervision. In this context, the idea of making AWS similar to humans by seriously considering feelings, human consciousness, will, etc., in their decision-making processes has emerged. This is only achievable through the confrontation of ideas, where AWSs focus solely on data and algorithmic calculations to accomplish their tasks by giving these robots more tasks and expanding their training domains towards activities that are so human.

The objective of training these robots, so that they think or reason like humans without human decision-making supervision, is still far from being achieved and even opposed by some ideologues, such as in our study case – Morocco – which questions the ability of these robots to understand Moroccan consciousness regarding the issue of Western Sahara. There are several reasons that underpin the refusal of experts and professionals in artificial intelligence for it to take over the decision-making from humans, specifically the aspect of human consciousness [28]. Especially when it is known that these robots can, in some cases, escalate the situation because their individual decisions cannot be reasonable or reliable in all scenarios.

In this process of algorithmic decision-making and data calculation, Taddeo (2024) estimates that human feelings and logic will no longer be taken into account by these robots and that, consequently, transparency, ethics, and fairness will no longer be respected [29]. Reinforced by studies on ethics and autonomous systems and the automation of human decision-making in critical situations, AWS pose significant problems when they can no longer avoid systemic biases and programming that can lead an autonomous system – far from the specificity of the situation – to make decisions based on injustices or exclusions, completely ignoring the human moral requirements of recourse, and the conduct of war enshrined in international law. This underscores the notion that human control is essential, serving as a fundamental principle whereby only individuals with decision-making-authority in matters of life and death can ensure logical decision-making, uphold accountability, and establish fairness and transparency in operational spaces and conflict environments [30].

3.3 General Theories of International Relations

According to Ndzendze and Marwala (2023) [31], the implications of AWS have serious impacts on the security and stability of the international geopolitical landscape. In the context of geopolitical tensions, emerging instability, and diverse security threats, states are no longer waiting for debates on the regulation of AWSs to fully mature before taking action to enhance stability and security. instead, they are actively pursuing largescale deployments of these systems to capitalize on their advantages in threat deterrence and security – despite the ethical, moral, and legal concerns they raise [32].

Also, the weakness that international law demonstrates in the face of the degradation of international trust and the inability to establish the global rule of law in several situations, particularly in holding defined actors on the international stage accountable. This contributes to the emergence of a sense of inter-state mistrust that encourages States to engage in individual processes to ensure the respect of their sovereignties by adopting specific initiatives, sometimes through the acceleration of armament or the adoption of innovative technologies to harness their benefits for national security [33]. Morocco, faced with this situation, should take the issue of deploying this technology seriously in light of the presence of a regional geopolitical context and a specific internal situation.

In this context, realism – emphasizing the independence of States in the international system to act as they see fit to safeguard national sovereignty and security – appears to have successfully shaped the adoption of this wave of technology and its integrations into military and security affairs. Unlike other well-known theories in international relations, the argumentation of this group of theorists has managed to highlight the competitive – even legitimate – nature of the processes involved in the development of weapon technologies, which nations generally adopt to ensure their superiorities and hegemonies [34].

And since AWSs are part of these programs, their adoption and allocation according to realists can exacerbate the global security dilemma and weaken efforts to maintain international stability and peace [35]. But according to them, the situation will not remain in chaos and overwhelmed by global instability because international efforts to find ethical and moral governance frameworks mark their importance and relevance through treaties, pacts, and conventions on AWS. International cooperation and collaboration can help us avoid the risks of AWSs, whose recognized paradigms offer us the potential to balance this game in favor of the standards and frameworks to be respected, alongside national security concerns [36].

This framework highlights the importance of the interdisciplinary approach we adopt to study this phenomenon and its implications for security and defense, as well as the use of the analytical potentials of the theories and concepts we believe are capable of deciphering the AWS dilemma in terms of sensitive decision-making and especially in the field of confrontations. The writings on AI and ethics have helped us provide guidelines for deploying a more concise and precise design in holding AWSs accountable, while concepts in international relations have given us a broader understanding of geopolitical and strategic issues. The paradigm we propose offers a broader foundation for evaluating and studying the complexity in modern conflicts and confrontations, especially for Moroccan decision-makers and authorities.

4   Methodology

Our methodology is based on a mixed approach to achieve our goal of making the implications and dimensions of the use of AWS understandable in the Moroccan context. With the integration of the qualitative method and specifically the analysis of academic and scientific content related to our issue, we aim to examine the geopolitical, ethical, and technological dimensions of the deployment of these systems in security and defense spaces, zones, and processes in relation to the specificities of Morocco as a country still suffering from territorial disputes.

We first conduct a systematic review of the accumulated literature in this research field, especially from countries that currently master these technologies and their processes from industrialization to deployment. This investigative process, which may include official documents and reports, roadmaps and public policy planning, academic and journalistic research, defense publications, as well as all other documents related to AWSs and their current uses, as well as AI and national security and defense. We aim, through this thorough review of documents and academic literature, in addition to understanding the challenges of AWS in the Moroccan context, to offer fundamental perspectives on the intersections and interactions in national security in the future due to the integration of these modern technologies. Moreover, our investigation will explore the ethical challenges of using and integrating these systems into critical security processes. We will examine their impact on carrying out essential tasks and activities, particularly regarding the pressures and responsibilities they may impose on Moroccan institutions in the eyes of the international community.

Finally, this methodology will help us improve transparency and accountability around the processes of using and adopting these systems by Moroccan defense and security institutions.

After the systemic reading, we proceed to case studies. Aimed at this, we present useful and well-known cases at the international level where the computer systems in question are used and well deployed on the ground, such as in Libyan and the Ukrainian conflict, to gain further knowledge about the studied technologies. In these cases, we can examine the questions we have developed around the implications and undesirable dimensions of these decision-making systems and technologies, as well as the weapons using these systems. In this part of the study, we also highlight the uses that may constitute arguments to reinforce or deny the ideas that the studied systems and weapons pose, e.g. a dilemma against ethics, law, war regulation, strategic planning, and the power game, etc.

It is important to recognize that Morocco differs from Ukraine and Libya, as the latter two are engaged in direct and open conflicts. Ukraine is in a state of total war with its adversary, Russia, While Libya is undergoing a civil war marked by clashes between political and ideological factions.

These two conflicts offer us an opportunity to better understand and learn about these systems widely used in these conflicts, and which can also serve as experiences to improve our national awareness of the impacts of using these systems and technologies without the necessary accompanying standards. While Morocco, on the other hand, is in a state of peace, but with intermittent skirmishes with separatist groups in the southern part of the country, including a situation of diplomatic tension with its neighbor Algeria, this gives Morocco a specific ground reality to consider when reconsidering the deployment of weapons and autonomous systems in these areas.

This specificity highlights the need to consider other uses of these systems within the unique geopolitical context of Morocco and its national and regional territorial concerns – particularly the complex border challenges, most notably the issue of Western Sahara. A deeper understanding of Morocco's case will help anticipate potential deployment scenarios of such systems and assess their implications for the country's national security.

At that time, the various territorial disputes in Moroccan Western Sahara can also help us understand the implications of these autonomous decision-making systems and how, in the case of irregular use, they can influence power and security dynamics in the region. Especially knowing that Morocco is fully integrating into a strategy to implement these systems to maintain its sovereignty and monitor its borders. We believe that examining these cases and specifics will provide a clearer understanding of the unforeseen impacts of these technologies. The diversity of conflict types, the varying levels of technological maturity among the studies, and the uniqueness of their geopolitical environments will reveal how these differences can be exploited to mitigate the impacts and concerns raised by professionals. This can be achieved by restricting or expanding the capabilities of these weapons and systems.

Subsequently, through systematic reading and the adoption of the case study, content analysis will extend to all other documents that can help us answer the research questions. Documentation, political, strategic, military, etc., and the consultation of previous studies can also help us evaluate Morocco's positioning regarding the cause of technological armament, including autonomous weapon systems. Through the analysis and study of military publications and the accounts of the relevant administrations, in Morocco or from consulted experiences, we can understand how the challenges of Morocco's digitization, particularly in terms of industry and financing national technological projects, as well as the challenges of human capital, hypothetically affect the processes of accountability and security. We believe that by combining these approaches, our method will succeed in providing a solid framework for evaluating autonomous decision-making and weapon systems in the Moroccan context, taking into account the imposed balances and requirements.

5   Evaluating and Analyzing Autonomous Weapons for Moroccan National Security, Governance and Ethical Considerations

We have concluded in this regard that the benefits of using these weapon systems are numerous in favor of Morocco's national security. Despite the peace process and the ceasefire signed with the insurgents, Morocco still suffers, as skirmishes with the separatists at border points in the southern region continue to violate and transgress the agreement, weakening the peace process and putting the region under tension. Moreover, the geopolitical context shown in Fig. 4 also weighs on these border points and areas by adding the challenges of cross-border crime from the Sahel region, which can take more dangerous forms against the security and stability of the region generally and Moroccan Western Sahara specifically. Also in the same geopolitical context, the control of Morocco's border areas, particularly in the regions surrounding the enclaved cities of Ceuta and Melilla, occupied by Spain, and the eastern region which is under border tensions with Algeria, and which sometimes experiences tensions due to waves of illegal migration and illicit smuggling activities, complicates the security situation and weakens national security strategies to stabilize the situation [37].
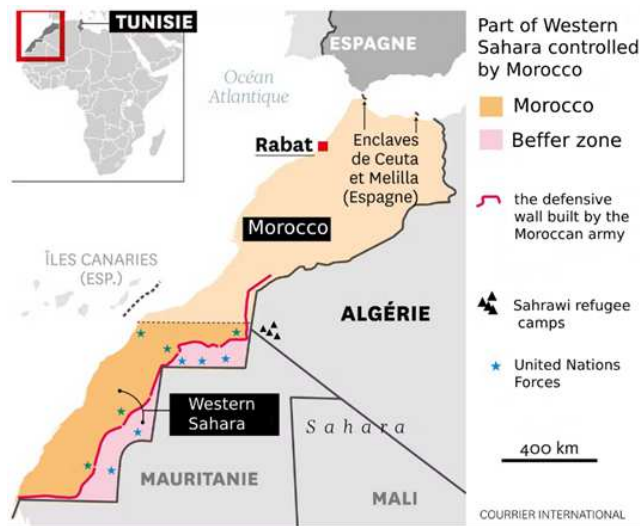
Fig. 4 Map shows the areas of territorial disputes of Morocco with his entourage [37]

These systems, considering the country's border challenges and territorial issues as well as its awareness of the fragile regional geopolitical context, offer unprecedented potential to Moroccan authorities to reduce costs, time, losses, and human resources, etc., and ensure the efficiency and precision of missions and the implementation of orders under the best conditions. Thanks to their significant potentials in automated surveillance and control as well as their sophisticated decision-making capabilities, they offer the Moroccan authorities enormous possibilities for the development and improvement of the performance and operability of national security measures as a whole. Owing to their operational potentials in security and military matters and the qualification and organization of destabilized areas and zones, or those that need additional surveillance and control to strengthen efforts on the ground for securing and stabilizing fragile zones, these systems can also play another important role in humanitarian efforts, far from military and security operations [38].

The potential of these systems in humanitarian affairs can be used in areas of natural disasters and in rescue and search missions, thus giving a boost to these systems in the military field. However, this duality and multitude of advantages highlight Morocco's willingness to acquire these systems, reflecting the country's expectations for their role in national defense. Their integration aims to deter threats and enhance the effectiveness of Morocco's defense and security structures.

In terms of risks, the widespread deployment of autonomous weapon systems in high-risk areas, military operations, or even civilian zones – such as border checkpoints replacing human personnel, like the enclaved cities of Ceuta and Melilla – could significantly increase the likelihood of accidents due to calculation errors. Additionally, interruptions or misinterpretations within algorithmic systems, as well as cyberattacks disrupting core functions, could escalate tensions and transform these systems from tools serving national interests into instruments of disruption, insecurity, and destabilization [39].

A bad decision made by these systems can, in addition to causing destabilization, demoralize societies and activities, because the lethal force used by these systems, besides being a monopoly of internal security services according to domestic law standards, remains also a human monopoly in decision-making according to the stand-

ards of international law of war and conflicts [40]. For this reason, before favorably qualifying these systems, Morocco must take greater consideration of the risks they pose to the security, stability, and morality of Moroccan society as a whole, before the massive deployment of this technology, especially in areas where it can cause unbearable and irreversible damage.

Alongside national and societal security issues, the deployment of the studied systems without strengthening national frameworks and standards for their use and activation can also raise questions of ethics, transparency, and accountability, and calls into question the reliability of decision-making and resolution processes. The systems used, despite their benefits, can in some cases raise several questions about the decision-making process and the algorithmic logic they adopt to qualify and distinguish the activity of an armed separatist insurgent or a terrorist, which aims at carrying out an act or an activity of armed sabotage, from that of a simple citizen or even a criminal aiming at carrying out an act or an activity under the control of these systems but with a basic density and scope. It is in this sense that fears continue to evolve, including the probabilities of transforming AWS from a solution to improve and strengthen security and stability, into challenges that multiply weaknesses and deficiencies.

In addition, hypotheses regarding the reinforcement of social inequalities due to the use of AI systems, particularly in civil activities, emerge and consolidate our ideas that AWS algorithms coupled with AI, by reinforcing the ethical divide, can generalize as challenges disrupting the decision-making process, social destabilization through the deepening of distrust, and discrimination among the components of such a society.

The mistrust surrounding these systems can lead to a wave of rejection or possibly protests and demonstrations against these systems, their decision-making logic, and the processes of their adoption and deployment, as was the case in certain countries and previous experiences of deploying these systems. Because these systems, in carrying out their tasks and activities, can support or endorse practices or activities previously deemed unjust or rejected by the logic of law and freedoms, such as deep surveillance activities and permanent control [41]. This analysis process prompts us to add that the internal context of Morocco can either encourage or discourage the emergence and development of the implications of autonomous decision-making systems, as well as their impacts on Moroccan society and its commitments to the international community, particularly in terms of law, trust, and responsibility. And so, in general terms, the introduction of autonomous systems without a deeper human awareness of their undesirable impacts can erode human dignity, encourage the violation of fundamental rights, and degrade trust and responsibility within international communities.

In Morocco, the desired and ongoing process involves strengthening governance frameworks and aligning AI adoption policies with legal, ethical, and regulatory standards. This approach should consider the broader public, political, and academic debates taking place in international forums. It also requires bringing together diverse segments of Moroccan society– including national think tanks, experts in emerging technologies, and AWS professionals from public, private, civilian and military sectors – to take the initiative and actively engage in ensuring the responsible deployment and effective integration of these technologies.

The challenge of AWS is not solely internal and related to local legal standards. However, regarding legal and regulatory challenges, particularly in international law, autonomous systems challenge the norms related to the applications of international humanitarian law as well as humanitarian standards. Proponents of AWS take advantage of the legal gaps in the interpretation and accountability processes of the studied sys-

tems, as well as the lack of international consensus around their uses and the areas of integration and deployment, to defend the importance and relevance of these systems and their ability to balance such a situation without any consideration of the requirements of legal issues and the consequences of this disruption of international regulatory and adaptation norms and instruments.

This situation of void leaves countries wishing to introduce AWS exposed to gaps in existing legal frameworks and inconsistencies of these frameworks with technological advancements undermining the processes of harmonious deployment of AWS. Because AWS, while they support and make defense and security activities more efficient, accumulate gaps when integrated into fragile security and geopolitical contexts or situations of gaps in national regulations regarding their use. In terms of international law, for example, the organization and regulation of war are still carried out according to traditional conditions and criteria of interstate confrontations in the international system, where the norms of Jus in Bello and Jus ad Bellum remain silent on these new uses of AWS, and do not confer any rights to these systems nor the privilege to make decisions on behalf of state decision-makers to conduct war or cease hostilities during an international conflict [42]. And by giving these systems the autonomy to make decisions in a fragile geopolitical context, this could, aside from legal gaps, expose states using these systems to politically and diplomatically sensitive situations if an AWS from one state decides to carry out armed activities against another state or cease armed activities in the midst of a confrontation, without referring to human decision-makers. Morocco, as a country wishing to deploy these systems, particularly in high-intensity border areas with geopolitical tensions, should take into consideration these dangerous applications of AWS and avoid their undesirable consequences.

At the national level, we have found that national law does not yet include specific provisions for the uses and applications of autonomous decision-making systems, and it also ignores the importance of a roadmap to uniquely address the challenges and issues of this technology. The legal void in the national framework for the regulation and organization of the specific governance of these systems is still real and existing, and it reflects a complete absence of specific regulations for such systems and all other related activities. This underscores the urgency of implementing a legal strategy aimed at reforming and consolidating existing legal frameworks and adding new legal and regulatory initiatives concerning use and responsibility, including strengthening integration into international processes and engaging in regional cooperation and collaboration processes. In the same vein, engaging in research and study initiatives can help Morocco steer its trajectory in the AWS deployment process, by combining similar frameworks derived from previous experiences to draft laws relevant to its context.

For greater clarity, Morocco should adopt a multidisciplinary strategy to fully harness the potential of AWS while mitigating risks and minimizing undesirable impacts, both domestically and in its interactions with the international community.

This is possible if Morocco engages in an official process and provides the necessary financial and human resources, as well as technological and industrial needs, to launch a national strategy specific to the uses and applications of AI, ending the period of gaps and legal voids and integrating important ethical, legal, and security considerations and requirements for the confident and responsible use of AWS. This national strategy should take into account the requirements of the national cybersecurity strategy as well as the Morocco 2030 vision, which aims to develop multiple mechanisms for investment, development, and cooperation, in order to strengthen Morocco's presence in the technological field at both regional and international levels.

Regarding governance and international cooperation, Morocco is supposed to strengthen the institutional and organizational process by establishing bodies and institutions responsible for monitoring and controlling the deployment processes and the functioning of these systems. The objective of this recommendation is to strengthen adherence to national internal principles and requirements and not to ignore them, prioritizing standards of accountability and international legal rules. Secondly, promoting international cooperation and collaboration with global actors – including states and the private sector – in the governance of AWS is essential to prevent undesirable impacts and unforeseen consequences from the irregular integration of these systems in the Moroccan context. Such cooperation efforts will support Moroccan decision-makers in shaping the responsible integration and use of AWS technologies.

In the same vein, Morocco should also strengthen its presence within international and regional organizations and benefit from previous experiences in the field. Cybersecurity measures for political or even geopolitical objectives are also important in this process, as cyberattacks currently target the vulnerabilities of these systems and take advantage of the transnational nature of the infrastructures that exploit them to carry out cyberattacks that disrupt functionalities and threaten the decision-making efficiency of the studied systems. For this reason, strengthening AWS cybersecurity protocols against cyberattacks is a necessity, and increasing investment rates in advanced cryptographic systems and resilient AI designs can help Morocco reduce the effects and vulnerabilities of AWS.

As Fig. 5 concludes, the human element is also essential in a national strategic plan specifically related to AWS. Raising public awareness about the ethical, legal, and societal implications of the human element is essential to foster trust and responsibility among individuals and to develop their awareness of the challenges posed by this emerging technology. Education is vital to facilitate the understanding of AWS, to ensure the implementation of this technology by avoiding several challenges and to encourage inclusive policies. By following these steps, Morocco can present itself as a leading country in the region and in the Arab and African world, a country with experience and a favorable image, to export it to countries that wish to introduce this technology and balance their internal frameworks and standards with the persistent challenges of AWS.

6   Conclusion

We had assessed the transformative potential of deploying autonomous weapon and decision systems, as well as the challenges and issues they pose for Morocco and its internal and international commitments. The fact that Morocco shows a deep willingness to deploy autonomous weapon systems (AWSs) is due to the fact that these systems offer unprecedented potential to modernize defense capabilities and develop national security, including optimizing military operations and providing a favorable contribution to humanitarian missions. Nevertheless, we have found out that Moroccan decision-makers, due to their limited understanding of the challenges and stakes of AWS and their ignorance of unpredictable scenarios that threaten national security and stability, are not yet aware of all the drawbacks of the ethical, legal, and strategic implications of the deployment process of these systems and their intended objectives. Hence, we are convinced that this controversial situation requires thorough political planning and understanding.
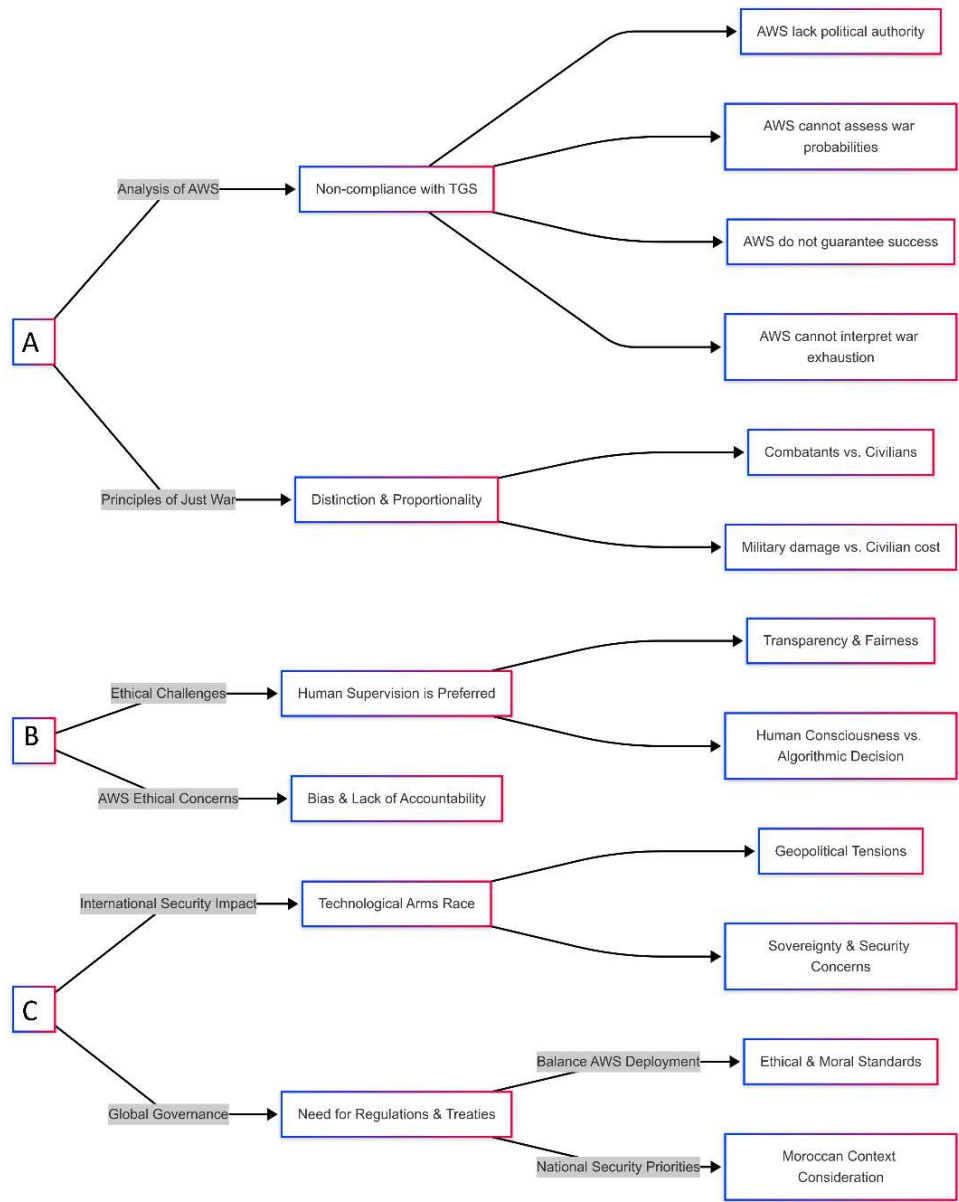
Fig. 5 Explaining the analysis in a mermaid form

At first glance, AWS truly offers unprecedented advantages for improving certain areas and sectors of logistics, surveillance, control, and optimization, particularly in the military and security fields. For this reason, Morocco demonstrates its ambition to adopt this technology and its willingness to deploy these systems in order to benefit from their advantages to consolidate its security grip in the face of emerging threats in its environment. Previous experiences with AWS and the examples included in the study show us that the systems examined offer better opportunities to strengthen border control and

surveillance, as well as to combat cross-border criminal movements in these fragile or tense areas. These systems can also put an end to the activities of terrorists and criminals in these blurred areas with low control and surveillance and also neutralize the movements of separatist groups harassing border areas and the Moroccan army.

In addition to their military capabilities and potential for warfare, AWSs also offer vast opportunities and hopes for their use in non-combat processes and applications. These systems can also help us improve the efficiency of rescue and emergency operations during periods of disasters and natural calamities.

In this regard, we observe that the systems studied operate in coordination with deployment frameworks and planning and adoption policies, and can never be deployed in isolation from legal, ethical, and political support strategies, etc. The risks that will be attributed to AWSs, as we demonstrated during our discussion and analysis process, are greater than we believe and may affect several vital areas and sectors. The negative reflection of the deployment and adoption process of AWS will encourage, in case of gaps, the spread of risks and dangers of use, and conversely, the respect for experiences and efforts in terms of security, trust, and responsibility will disrupt the rules of international law regulating war and humanitarian operations within a military conflict or even in a situation of peace. In addition to deployment processes, other risks and dangers that should not be overlooked include the accidental escalation of conflicts, which can ruin a fragile peace situation, or a non-confident ceasefire.

The accumulation of these challenges can weaken both international regulation and national legal frameworks. Furthermore, pressing concerns around ethics, human rights, and the erosion of human agency in decision-making demand urgent vigilance. Without careful attention, these issues risk widening the gap between the intended objectives of using AWS (Autonomous Weapon Systems) and the significant dangers they may pose.

The presentation of this range of risks alerts us to the importance of adopting a multifaceted and multidisciplinary approach to address such issues and also to impose the necessary safeguards, whether legal, ethical, technological, or human.

Our study includes the factor of Morocco's sociopolitical and cultural context and how it contributes to the complexity already discussed in the previous paragraphs. The dilemma of transparency and accountability, as well as the acceptance of decisions and actions by machines, requires major reforms and profound solutions within the culture of Moroccan society. Technologies in general, especially those developing in the realm of autonomous decision-making by harnessing the potential of artificial intelligence, are no longer within the circle of trust of citizens not only in Morocco but also globally. Citizens of the world doubt the logic and ethics of their decisions towards humans, as machines can never replace human interpretation, which alone has the ability to distinguish and judge human causes and the concepts of good and evil.

At the same time, there is also the issue of aligning national legislation with international standards and experiences, highlighting, the necessity and importance of a proactive, progressive, and adaptive regulatory approach. We found that during our analytical process, Morocco's 2030 cyber strategy, despite its efforts to fill the gaps in legal texts and to outline the national vision according to the general requirements of the technological field, does not yet include specific provisions regarding the adoption, use, and application of AWS.

We have noted the recommendations to improve the exploitation potentials and profiles of the Moroccan AWS authorities, which we wish to enumerate precisely in this conclusion. AWS coupled with the potentials of artificial intelligence require Morocco to engage in a specific strategy in accordance with international standards and the legal

heritage of the international community, taking into account internal requirements and impositions where security priorities weigh on the processes of study and interpretation, whether they are ethical, legal, and/or security-related. The deployment process, therefore, should take internal specificity into account as a principle of analysis and operation and not blindly follow processes that could distort implications and destabilize an already fragile situation. In short, the national strategy for AWS and related systems must be aligned with existing international best practices while considering Morocco's priorities and specificities in the fields of freedom, security, politics, law, diplomacy, etc.

In addition, we also recommend strengthening the current institutions and mechanisms dedicated to addressing technology-related issues in general, as well as consolidating the existing legal and regulatory frameworks. In this regard, we also recommend the establishment of specific mechanisms to monitor and regulate the use and activities of AWS, taking into account the implications for Moroccan society. The establishment of a clear and transparent governance process will help policymakers and researchers better understand the future challenges and issues of AWS and will also promote the implementation of trust and legitimacy of these processes in the eyes of the public.

Furthermore, strengthening institutional processes and national regulations to guide the deployment and integration of AWS should be accompanied by investment in existing national capacities and the mobilization of potential resources for research, development, and technological infrastructure. These efforts are essential to support and advance national capabilities. Collaboration must extend beyond traditional circles of cooperation and negotiation, drawing on the centers, and international partners. Such inclusive practices are key to building robust, locally grounded expertise.

Strengthening the state's commitments in cooperation processes is also a process that should not be neglected, where Morocco should align its efforts and open its proposals with collaborations with regional and international organizations dedicated to the study and regulation of technological issues, thus allowing the country to contribute to international efforts to standardize AWS while accessing innovative experiences and best practices. In this area, strengthening cybersecurity is also important to reduce the vulnerabilities of AWS, for which Morocco should renew and develop its cybersecurity protocols and invest in resilient AI initiatives. We see that these measures are important and crucial for the uninterrupted and permanent operation of the studied systems, without interruptions or failures, and also essential to ensure operational integrity.

Finally, raising awareness and including the general public in the deployment process of AWS helps avoid certain implications against society and security. This phase consolidates individuals' trust in the procedures adopted by the Moroccan authorities and also ensures individuals' contribution to the democratic process of making the use of AWS more confident and responsible. To further clarify this contribution and awareness, we have recommended that educational programs also include educational plans and transparent communication programs among the various stakeholders within training and educational institutions in order to build a societal consensus favourable to AWSs and their responsible use.

For Morocco to successfully integrate and positively implant AWS in the fields of defense and security, it requires the adoption of a balanced approach that can position it regionally as a leader and internationally as an important player with notable experience in the use and regulation of AWS. This strengthens national security, the stability of areas using its systems for control and surveillance, facilitates Morocco's integration

into future initiatives around these issues, and finally promotes Morocco's positioning in global efforts to shape the fairness and sustainability of AI and autonomous systems.

Acknowledgement

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