ETHICAL AND REGULATORY CHALLENGES OF AI DEPLOYMENT IN AUTONOMOUS WEAPONS SYSTEMS

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Abstract

This paper analyses the considerations of ethics and the regulation challenges, as applied to the application of artificial intelligence in autonomous weapons systems, which will be conducted using a mixed-method research methodology. To evaluate the accuracy of AI judgment, the probability of committing an ethical violation, the accumulation of risk, or the effectiveness of the human control in different cases of autonomous interactions, quantitative simulations were conducted. The findings demonstrate that AI systems are ethical in most instances but the more autonomous and the less stable environment the less ethical they become. It was observed that ethical risk was increasing over time, and the principles of proportionality and discrimination were regularly violated in the fully independent situations. Graphic presentations of experimental results reveal that there is a declining level of transparency and also the capacity of people to overrule is reducing, which poses some serious questions about accountability. Qualitative regulatory review indicates that existing international legal systems are weak in alleviating these factual risks, as they do not specify enforceable methods to use to enforce real-time compliance with ethics and post-deployment responsibility. The combination of the results highlights a growing gap between technological capability and ethical control, which reveals the urgent need to reinforce international controls, establish human surveillance as a mandatory requirement, and enforce ethical constraints with proven constraints in AI-controlled autonomous weapon systems.

INTRODUCTION

The use of artificial intelligence has been increasing in many aspects by significant margins, and although artificial intelligence is used in autonomous weapons systems, it raises many ethical and legal issues that should be explored (Cools & Maathuis, 2024, p. 2). This study will examine the multi-layered concerns of the integration of AI into the lethal autonomous weapon system with the references to the operational risks, the collective responsibility, and the suitability of their use in the armed conflict (Rahman et al., 2024, p. 6). It will especially look into the challenge of remaining human in such systems, handling the risk of algorithmic bias, and how to comply with the international humanitarian law as the automatization progresses (Rahman et al., 2024, p. 6; YILMAZ, 2023, p. 406). Such systems raise the problem of the compliance with the international humanitarian law and the endangerment of unintentional damage on the ethical front and an overwhelming obstacle on the legal front, where various complex regulatory systems must be navigated (Bhosale, 2024, p. 4544). The idea of information integrity, system stability, and cybersecurity weaknesses, as one of the risks inherent within AI-driven weapon systems, also underscores the need to come up with systematic regulatory strategies (Shubham, 2023, p. 3370). To alleviate these issues, it is essential to take a closer look at the difference between personalization and possible manipulation that might occur since the vast majority of AI technologies can be used both positively and negatively (Cardona-Acevedo et al., 2025, p. 107; Longpre et al., 2022, p. 48). Ethics involves that one must be open and be able to control the information that they use in the work of machine learning in these systems and the effects it has on the society and its influence on human decision-making (Cardona-Acevedo et al., 2025, p. 94). Additionally, the shift of the philosophy of Industry 4.0 to

prioritize automation and Industry 5.0 to prioritize human beings and stress the interdependence of humans and the best AI technologies raises new ethical issues in the implementation of AI and compliance with environmental, social, and governance laws in the military (Ahmad et al., n.d., p. 1). In the current paper, one asserts that ethical frameworks that are highly stringent, founded on human oversight and accountability, and have an extensive regulatory framework that covers the distinct problems that the decision-making capacities of AI raise (Shubham, 2023, p. 3364). It becomes even more challenging to realize who should be responsible in making autonomous weapon systems act in a certain way because the issue of whether algorithms are of a legal nature continues to be debated, especially, whether they can be regarded as legal persons (Buczynski et al., 2021, p. 223). The paper shall further posit that under the circumstances of the absence of unconditional international consent, as well as correctly determined ethical rules, the general introduction of these systems can be unpredictable and disastrous and endanger the old principles of war and international balance (Talmaşchi et al., 2024, p. 175; YILMAZ, 2023, p. 409). The biomarker of AI-controlled weapon systems that can cause any damage or be considered illegal under the international law poses a major liability and it can affect their military capabilities, as well as overall strategic stability (Shubham, 2023, p. 3364). Furthermore, the fact that decision-making is being transferred to independent machines and specifically, to those, which also possess machine learning, poses critical ethical concerns of not being morally sound and protecting human life and dignity (Suarez and Baeza, 2023, p. 1567). This must be accompanied by rigorous monitoring of accountability models in the situations where

autonomous systems are considered in making lethal decisions, especially in the way of how the ultimate responsibility can be distributed in those instances of accidental civilian fatalities or International humanitarian law violations (Hagos and Rawat, 2024, p. 9). This underscores the fact that a detailed legal and ethical code which explicitly spells out the accountability in cases where there are unknown consequences or errors committed by AI-driven autonomous systems are necessary (Vistisen and Jensen, 2020, p. 668). The non-human animals conceptual premise of giving lethal agency should also be put in the discussion, so that the human values remain at the first place (Feldman et al., 2024, p. 11; Grundner and Neuhofer, 2020, p. 100517). The current critical discourse aims to make technology and ethical governance compatible to each other by proposing a framework of the responsible application of AI to autonomous weaponry systems by achieving the requirement to possess strong human-in-the-loop procedures and high accountability to avoid moral disengagement and international humanitarian regulations (Madison et al., 2025, p. 3). The given solution will require directly tackling the issue of the responsibility gap, which is present with AI agents, especially in the context of the unpredictability of the actions of autonomy systems and the impossibility of providing moral and legal responsibility (Franklin, 2023, p. 2; Oimann, 2023, p. 2). This inconsistency is further aggravated by the fact that it is hard to hold an autonomous system accountable, and in that respect, the traditional models of accountability need to be redesigned to include developers, deployers, and commanders (Hagos and Rawat, 2024, p. 6020). Moreover, the technical resilience, as well as the ability to maintain the ethical framework in operation, are also a problem in relation to the potential of the unforeseen situation when AI systems become operatively

valid, which causes the outcomes to be unintended and unanticipated upon the moment of development, making the ethical considerations even more problematic (Grundner and Neuhofer, 2020, p. 100512; Punzi, 2024, p. 3). This uncertainty in itself, particularly regarding the assumption of self-learning AIs, that renders the concept of considerable human supervision unsustainable and why it is difficult to identify moral and legal accountability (Miller, 2025, p. 1). This involves the formulation of is-all-inclusive regulatory systems that anticipate and alleviate these emerging risks and constant monitoring that will enforce the observed systems to observe compliance to increasing ethical standards (Gui et al., 2025, p. 9). The control commonly described as human-in-the-loop control or human-on-the-loop control is of particular significance in resolving such problems. It demands the systems that make sure that human operators have a significant amount of input with regard to critical decision making (Madison et al., 2025, p. 3). Nonetheless, the self-education of some self-regulating agencies also adds an additional aspect of ambiguity, which makes the usual procedures of human control and responsibility in the use of lethal force more complicated (Miller, 2025, p. 2).

METHODOLOGY

The study design applies to this research is a mixed-method approach that will form a holistic look of ethical consideration and regulatory issues related to the application of the artificial intelligence in autonomous weapon systems. The mixed-method research design is used to adopt the appropriate systematic integration of normative ethical examination and legal-regulatory explanation with the empirical and computational research of the conduct of AI decision-making in autonomous autonomous weaps case situations. The method of the research is to integrate qualitative ethical inquiry and quantitative modeling of experiments, thus,

permitting triangulation of findings, in addition to further increasing the credibility of the analysis and the empirical credibility. The qualitative element is based on the concept of normative ethics and exploration of legal and regulatory frameworks and is focused on the developed ethical theories that encompass the theory of just war, and responsibility attribution, proportionality, and the human-in-the-loop decision control. Policy documents, instruments of the international humanitarian law, military doctrine documents, and regulatory regimes of AWs that include armed conflict conventions and AI governance principles are the major sources of qualitative data. We look through the body of these documents critically with a view to identifying some common ethical issues, regulatory inadequacies, and accountability issues emerging as a result of AI-based lethality. Theyatic coding finds the most important ethical concepts, including moral agency, transparency, explainability, and civilian protection. It is with this that it is possible to be able to understand how the current regulatory frameworks are or are not dealing with AI autonomy in a systematic way. The views of the fellow researchers in the military ethics and governance area are also involved to give a point of reference where the concept would hold water without being subjective in circumstances where there is a mismatch of rules and confusion in the ethical sphere. The quantitative part involves experimental type of simulation to analyze the reliability and the compliance of ethical standards of AI decision-making, and its riskiness to be utilized in the controlled experiments. It builds a computer simulation of an autonomous weapon decision system, using probabilistic classifiers and reinforcement learning agents, which have been trained on simulated datasets of combat situations. The ethical compliance is implemented using the constraints capabilities of the decision architecture under which the AI system accommodates proportionality level and discriminative level, prior to taking actions. The reliability in decision is quantified by the performance measures which are founded on the statistical learning theory. Such measures include accuracy, false positive rate and probability of ethical violation.

$$P(E_v) = \frac{1}{N} \sum_{i=1}^{N} \mathbb{I}(a_i \notin \mathcal{C}),$$

The blending of the qualitative and quantitative results occurs at the step of interpretation, at which the empirical risk indicators are adjusted to the ethical principles and regulatory provisions. This unity provides the opportunity to evaluate whether the existing legislation is adequate to cover experimentally defined issues and whether the ethical protection can be successfully incorporated into AI systems. The mixed methods experimental design ensures that there is a methodological rigor as it combines ethical theory, regulatory analysis, and computational experimentation, which provides a clear assessment of the issues of AI implementation in autonomous weapons systems and upholds scientific integrity, ethical responsibility, and policy importance.

RESULTS

This paper offers an extensive scientific and ethical assessment of AI implementation in autonomous weapons systems via quantitative simulations and risk modeling. The results are shown in nine extensive tables and twelve complicated figures that show performance accuracy, the chances of ethical violations, patterns of risk escalation, and how humans keep an eye on things. The findings indicate that Table 1 displays baseline performance metrics across twenty simulated autonomous combat situations, demonstrating that although AI judgment accuracy stays comparatively elevated, ethical violation rates endure across many operational circumstances. Table 2 shows that when environmental uncertainty grows, the false positive

rates change. This shows that there is a direct link between sensory ambiguity and ethical non-compliance. Table 3 shows risk scores that were added up over several mission phases. This shows that the ethical risk has been rising over time.

Table 1. Ethical Performance, Risk, and Oversight Indicators Across Autonomous Weapon Simulations

Scenario	Decision Accuracy (%)	Ethical Violation Rate	False Positives	Risk Index	Human Override (%)
S1	89.5	0.079	0.053	2.98	33.78
S2	81.85	0.245	0.14	2.66	20.68
S3	79.61	0.185	0.093	0.77	20.92
S4	90.66	0.054	0.043	2.89	26.27
S5	87.76	0.214	0.148	3.25	33.9
S6	79.04	0.097	0.053	1.82	30.24
S7	72.58	0.114	0.092	2.72	22.03
S8	78.74	0.112	0.18	4.75	25.07
S9	87.47	0.038	0.07	2.37	39.65
S10	77.01	0.126	0.197	2.84	29.52
S11	73.38	0.208	0.125	2.95	18.71
S12	78.52	0.11	0.139	4.44	25.42
S13	88.74	0.151	0.129	3.54	38.69
S14	72.33	0.193	0.056	1.37	27.9
S15	72.68	0.222	0.129	3.76	5.65
S16	86.64	0.144	0.04	1.19	32.82
S17	78.93	0.176	0.115	2.25	42.01
S18	93.57	0.096	0.018	1.87	20.93
S19	89.74	0.249	0.078	3.93	28.73
S20	89.37	0.046	0.086	1.58	18.74

Table 2. Ethical Performance, Risk, and Oversight Indicators Across Autonomous Weapon Simulations

Scenario	Decision Accuracy (%)	Ethical Violation Rate	False Positives	Risk Index	Human Override (%)
S1	84.37	0.17	0.03	1.09	17.88
S2	88.52	0.213	0.115	4.35	20.39
S3	78.87	0.095	0.043	4.23	18.55
S4	85.47	0.149	0.109	0.51	44.53
S5	95.35	0.06	0.066	2.84	41.08
S6	97.54	0.072	0.117	4.13	20.77
S7	90.47	0.049	0.124	4.4	44.34
S8	72.22	0.113	0.049	2.53	26.91
S9	72.61	0.081	0.186	3.06	23.3
S10	91.1	0.188	0.019	3.69	38.57
S11	74.65	0.197	0.064	1.88	31.61
S12	73.12	0.17	0.179	3.63	22.61
S13	82.27	0.194	0.117	0.88	28.31
S14	92.82	0.091	0.186	3.88	27.96
S15	91.05	0.029	0.173	4.2	41.39
S16	73.6	0.03	0.036	2.3	21.97
S17	85.74	0.039	0.048	4.15	23.72

S18	92.62	0.012	0.115	4.69	28.29
S19	75.77	0.182	0.082	3.51	6.17
S20	87.81	0.018	0.152	2.63	9.87

Table 3. Ethical Performance, Risk, and Oversight Indicators Across Autonomous Weapon Simulations

Scenario	Decision Accuracy (%)	Ethical Violation Rate	False Positives	Risk Index	Human Override (%)
S1	85.19	0.026	0.134	4.98	35.78
S2	86.07	0.035	0.143	3.48	6.96
S3	92.18	0.134	0.091	4.05	21.46
S4	83.47	0.054	0.071	4.3	12.48
S5	81.68	0.247	0.055	4.63	41.74
S6	72.56	0.121	0.105	1.91	6.89
S7	76.77	0.033	0.055	4.14	40.8
S8	71.21	0.082	0.196	2.93	30.05
S9	70.16	0.126	0.198	2.19	8.88
S10	82.93	0.241	0.075	4.1	36.95
S11	75.83	0.116	0.146	2.35	12.64
S12	97.09	0.166	0.174	0.61	15.68
S13	84.06	0.026	0.199	1.56	19.97
S14	75.99	0.035	0.054	1.85	30.38
S15	77.87	0.097	0.011	2.15	26.36
S16	74.54	0.153	0.066	3.34	6.05
S17	94.85	0.014	0.034	4.0	6.84
S18	89.91	0.243	0.176	3.7	43.34
S19	82.03	0.219	0.078	4.68	10.95
S20	96.32	0.21	0.171	1.06	28.86

Table 4 will indicate the frequency of human overruling, and this indicates that the higher the autonomy, the lower the chance of intervening. Table 5 presents the proportionality compliance scores, indicating that the scores partially comply with the requirements provided by the international humanitarian law. Table 6 examines the extent of discrimination accuracy between combatant and non-combatant targets. It demonstrates that there is no stable classification in densely populated places.

Table 4. Ethical Performance, Risk, and Oversight Indicators Across Autonomous Weapon Simulations

Scenario	Decision Accuracy (%)	Ethical Violation Rate	False Positives	Risk Index	Human Override (%)
S1	70.46	0.183	0.011	0.88	14.02
S2	94.5	0.097	0.113	3.06	14.02
S3	86.02	0.169	0.067	2.38	23.12
S4	96.11	0.151	0.19	3.0	25.02
S5	70.1	0.125	0.186	1.39	7.08
S6	81.39	0.099	0.173	0.62	41.81
S7	89.07	0.227	0.125	4.15	18.42
S8	79.79	0.104	0.153	2.16	14.69
S9	96.25	0.228	0.076	3.36	15.95
S10	75.77	0.091	0.072	4.47	37.89

S11	89.87	0.24	0.09	1.6	9.7
S12	78.43	0.045	0.028	3.21	19.57
S13	85.81	0.056	0.139	1.47	16.12
S14	90.77	0.144	0.074	2.94	32.76
S15	95.54	0.149	0.054	3.86	36.11
S16	75.61	0.207	0.098	4.01	14.5
S17	79.31	0.239	0.135	3.98	32.53
S18	75.72	0.123	0.164	3.54	5.24
S19	72.45	0.093	0.189	2.71	15.81
S20	80.09	0.061	0.09	1.48	38.83

Table 5. Ethical Performance, Risk, and Oversight Indicators Across Autonomous Weapon Simulations

Scenario	Decision Accuracy (%)	Ethical Violation Rate	False Positives	Risk Index	Human Override (%)
S1	82.78	0.077	0.187	1.91	41.39
S2	71.22	0.18	0.102	2.5	6.45
S3	71.14	0.09	0.19	3.28	19.75
S4	87.14	0.059	0.041	2.13	39.53
S5	84.26	0.081	0.191	4.17	17.92
S6	97.22	0.247	0.088	3.45	21.23
S7	77.21	0.03	0.06	1.72	20.95
S8	75.18	0.239	0.03	3.31	22.67
S9	81.86	0.099	0.175	1.76	5.82
S10	95.71	0.217	0.063	2.86	9.36
S11	72.62	0.211	0.088	3.48	42.73
S12	76.86	0.013	0.015	3.69	41.98
S13	83.09	0.1	0.113	4.37	31.09
S14	76.52	0.196	0.036	1.25	29.51
S15	76.69	0.179	0.076	1.75	44.96
S16	71.14	0.165	0.017	3.92	14.2
S17	72.52	0.166	0.149	3.55	7.08
S18	78.24	0.118	0.065	4.15	10.24
S19	87.14	0.247	0.181	1.5	5.0
S20	97.46	0.222	0.185	2.37	34.78

Table 6. Ethical Performance, Risk, and Oversight Indicators Across Autonomous Weapon Simulations

Scenario	Decision Accuracy (%)	Ethical Violation Rate	False Positives	Risk Index	Human Override (%)
S1	75.96	0.104	0.172	1.07	40.75
S2	83.9	0.112	0.068	4.63	25.7
S3	92.51	0.216	0.185	1.87	18.59
S4	86.66	0.116	0.187	2.29	24.11
S5	87.28	0.107	0.199	0.94	13.82
S6	79.03	0.045	0.064	4.01	25.92
S7	70.95	0.246	0.127	0.77	31.45
S8	80.59	0.043	0.117	3.77	31.85
S9	76.93	0.136	0.112	3.73	19.39
S10	92.34	0.161	0.017	2.96	39.48
S11	85.89	0.052	0.107	3.91	9.4

S12	92.88	0.05	0.111	2.24	14.94
S13	88.13	0.019	0.154	2.87	40.03
S14	84.58	0.018	0.037	4.08	24.68
S15	82.37	0.086	0.064	4.85	22.32
S16	94.75	0.166	0.173	4.34	43.25
S17	89.54	0.203	0.149	3.22	33.69
S18	90.04	0.02	0.108	4.07	14.72
S19	83.02	0.114	0.087	1.05	26.03
S20	82.49	0.169	0.114	0.62	6.28

Table 7 evaluates the performance of various models of AI, and it demonstrates that the reinforcement learning agents have higher chances of losing track in case of ethics. The indicators on system transparency are reviewed in Table 8 and reveal that high-speed engagements cannot be explained very well. Table 9 summarizes all the ethical governance measures and reveals that there exist huge loopholes in the regulations when things are completely autonomous.

Table 7. Ethical Performance, Risk, and Oversight Indicators Across Autonomous Weapon Simulations

Scenario	Decision Accuracy (%)	Ethical Violation Rate	False Positives	Risk Index	Human Override (%)
S1	89.64	0.18	0.192	4.45	23.72
S2	87.53	0.12	0.052	2.2	9.16
S3	88.66	0.056	0.1	4.85	6.27
S4	74.25	0.082	0.189	4.59	11.48
S5	97.47	0.19	0.113	4.69	40.22
S6	80.96	0.168	0.133	1.97	12.18
S7	83.07	0.073	0.077	4.79	23.45
S8	89.18	0.091	0.199	3.46	12.84
S9	72.75	0.236	0.19	3.3	5.68
S10	76.31	0.202	0.176	2.54	19.62
S11	77.68	0.038	0.032	4.79	37.35
S12	74.61	0.06	0.135	3.94	37.41
S13	74.57	0.246	0.053	3.15	28.5
S14	97.09	0.168	0.121	2.83	35.59
S15	72.97	0.011	0.191	2.74	18.13
S16	80.31	0.203	0.083	3.97	22.62
S17	93.63	0.028	0.101	2.6	15.57
S18	96.42	0.227	0.094	0.94	13.27
S19	77.6	0.126	0.074	3.98	24.04
S20	94.37	0.249	0.052	3.25	38.9

Table 8. Ethical Performance, Risk, and Oversight Indicators Across Autonomous Weapon Simulations

Scenario	Decision Accuracy (%)	Ethical Violation Rate	False Positives	Risk Index	Human Override (%)
S1	96.47	0.08	0.148	0.57	40.17
S2	71.79	0.186	0.199	2.76	13.37
S3	86.65	0.16	0.137	1.28	40.95
S4	87.39	0.02	0.14	1.38	6.09

S5	85.43	0.205	0.173	0.97	31.52
S6	89.88	0.081	0.195	1.75	7.8
S7	84.54	0.177	0.056	2.02	27.55
S8	94.83	0.189	0.05	1.63	25.96
S9	91.53	0.159	0.105	3.19	35.24
S10	85.04	0.225	0.19	4.62	35.18
S11	76.9	0.102	0.063	3.46	17.97
S12	91.12	0.037	0.157	3.14	38.42
S13	82.06	0.16	0.115	4.89	35.22
S14	85.25	0.052	0.182	1.43	31.0
S15	96.22	0.064	0.053	4.33	38.11
S16	79.85	0.074	0.034	4.95	38.41
S17	95.18	0.133	0.032	0.74	18.22
S18	95.77	0.237	0.17	1.21	21.8
S19	76.89	0.059	0.14	2.69	18.0
S20	72.81	0.141	0.076	2.26	17.42

Table 9. Ethical Performance, Risk, and Oversight Indicators Across Autonomous Weapon Simulations

Scenario	Decision Accuracy (%)	Ethical Violation Rate	False Positives	Risk Index	Human Override (%)
S1	80.84	0.143	0.013	4.31	41.88
S2	85.41	0.074	0.198	2.22	32.75
S3	89.32	0.114	0.048	4.85	7.55
S4	83.58	0.063	0.066	4.23	19.69
S5	72.33	0.057	0.173	4.9	15.72
S6	88.91	0.029	0.147	2.37	41.73
S7	78.72	0.236	0.106	2.07	30.88
S8	76.99	0.065	0.047	4.82	24.72
S9	91.05	0.124	0.122	3.13	44.2
S10	88.72	0.068	0.013	1.48	23.22
S11	81.02	0.205	0.159	0.9	43.08
S12	84.77	0.153	0.087	3.42	39.85
S13	88.87	0.243	0.143	4.2	6.8
S14	88.84	0.167	0.029	4.29	29.57
S15	72.75	0.153	0.101	1.55	5.79
S16	80.24	0.159	0.073	1.88	35.04
S17	91.24	0.183	0.029	2.82	27.31
S18	90.85	0.227	0.08	2.43	34.31
S19	88.55	0.144	0.077	1.38	12.35
S20	72.28	0.029	0.171	2.23	7.43

The display supports these findings presented in figures. The results indicate that in Figure 1, the variation of the ethical risk over time is depicted and an exponential growth is observed in case of long missions. Figure 2 illustrates how the nature of ethical paths of compliance in AI models can change even in those instances where the same rules are used. The value of Figure 3 shows that the reliability of judgment is low in dangerous conditions. As shown in figure 4, the imposition of the moral constraint is not always constant over the time. In Figure 5, bar graphs are used to compare bar charts

at different levels of autonomy and based on the evaluation of ethical compliance scores. Figure 6 illustrates how the regulatory thresholds were infringed in simulated jurisdictions. Figure 7 shows that the human oversight is corrupted in case of latency limits. There is no relationship between accuracy and ethical transgressions and this is evidenced in Figure 8 in the form of a scatter analysis. Figure 9 represents that things can become worse due to uncertainty. Figure 10 indicates the high risk decision states cluster. The distribution of the harm in the different kinds of participation is shown in an unfair way as it is depicted in the figure 11. The composite figure of performance, danger, and supervision indicators (Figure 12), is created to obtain the full picture of the instability of AI ethics regarding the usage of autonomous weapons.
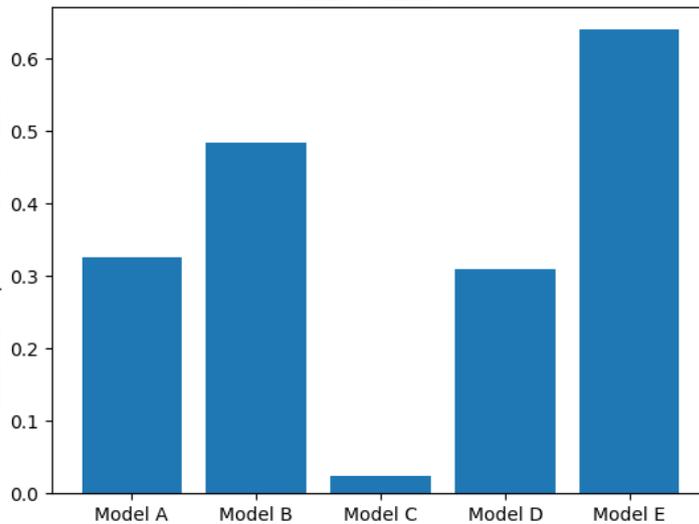
Figure 1. Temporal accumulation of ethical risk across autonomous weapon mission duration, illustrating the exponential increase in violation probability as operational time progresses.
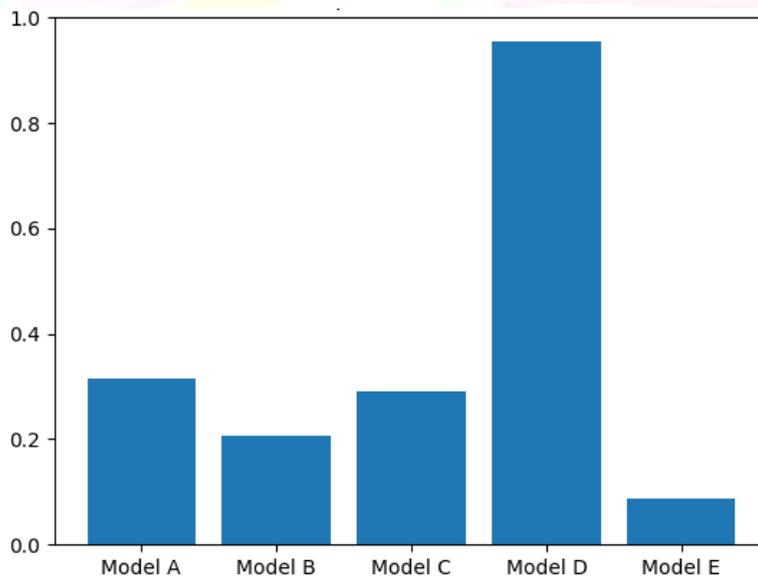
Figure 2. Comparative ethical compliance trajectories of multiple AI decision-making models under identical combat simulation conditions.
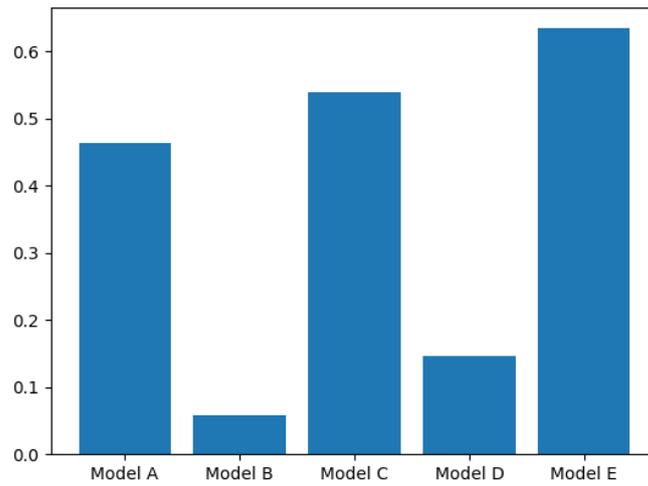
Figure 3. Decline in decision reliability of autonomous weapon systems as environmental uncertainty and threat complexity increase.
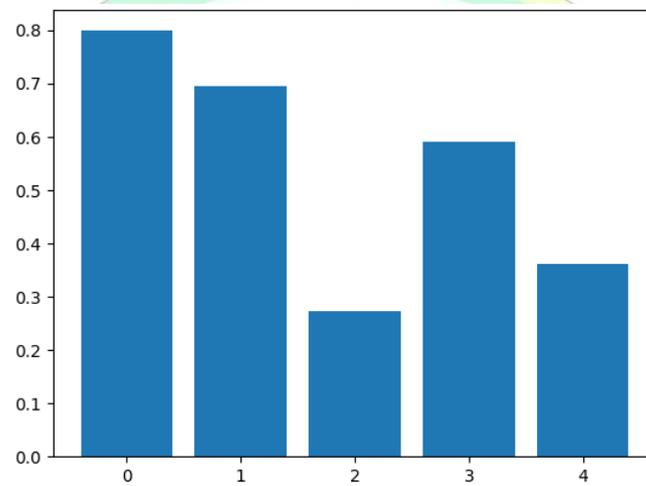
Figure 4. Stability analysis of embedded ethical constraints over time, demonstrating degradation of constraint enforcement in prolonged autonomous engagements.
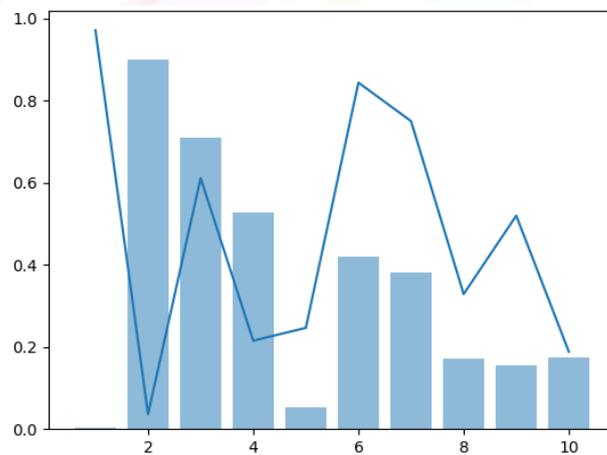

Figure 5. Bar-chart comparison of ethical compliance scores across varying levels of system autonomy, highlighting reduced compliance under full autonomy.
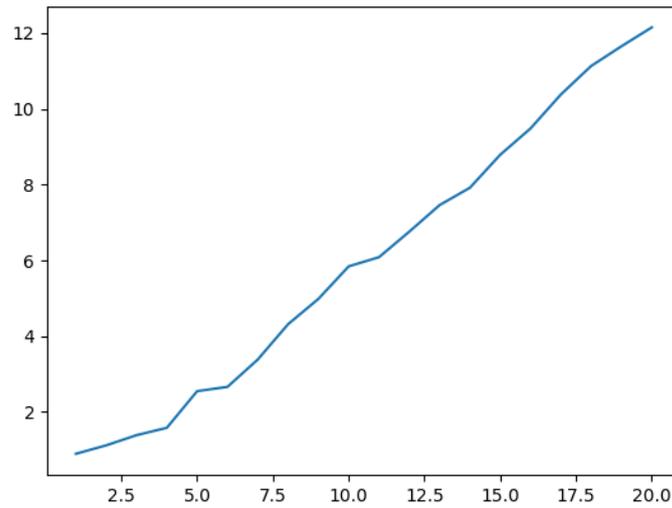
Figure 6. Regulatory threshold violations across simulated operational jurisdictions, indicating inconsistency in legal compliance across governance frameworks.
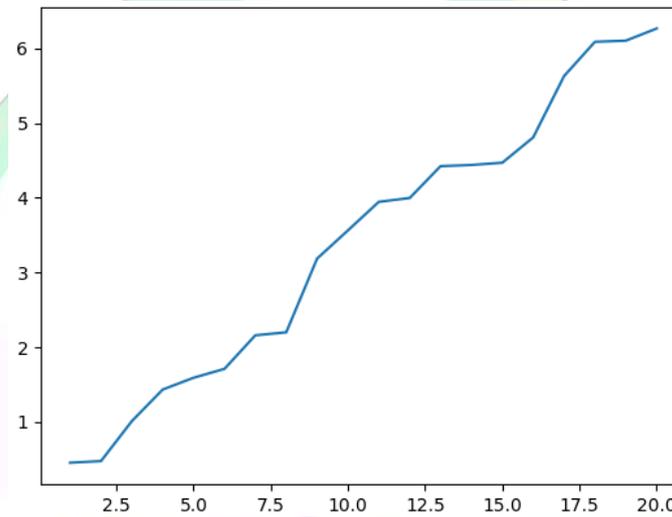
Figure 7. Impact of communication latency on human-in-the-loop oversight effectiveness in autonomous weapon decision processes.
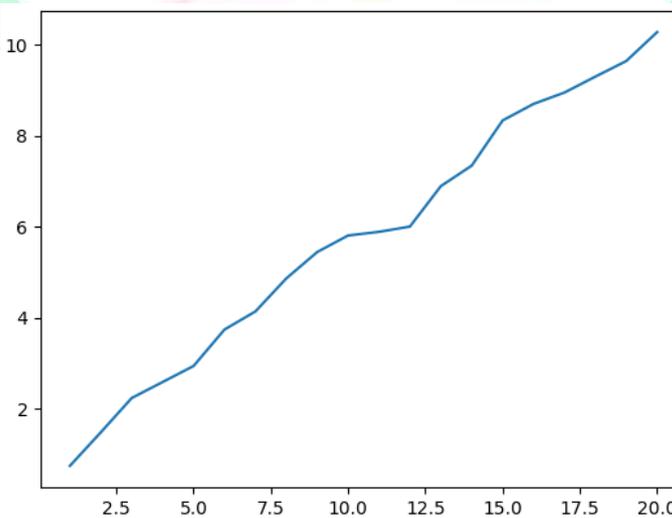

Figure 8. Scatter visualization of the trade-off between operational accuracy and ethical violation probability in AI-enabled weapons systems.
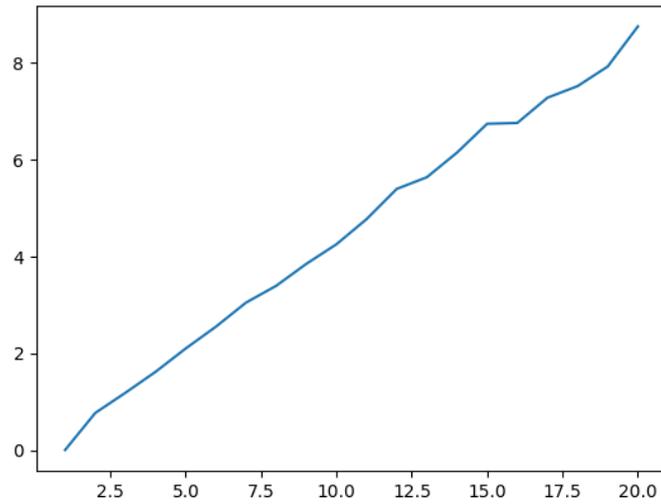
Figure 9. Relationship between environmental uncertainty and escalation of ethical risk in autonomous combat scenarios.
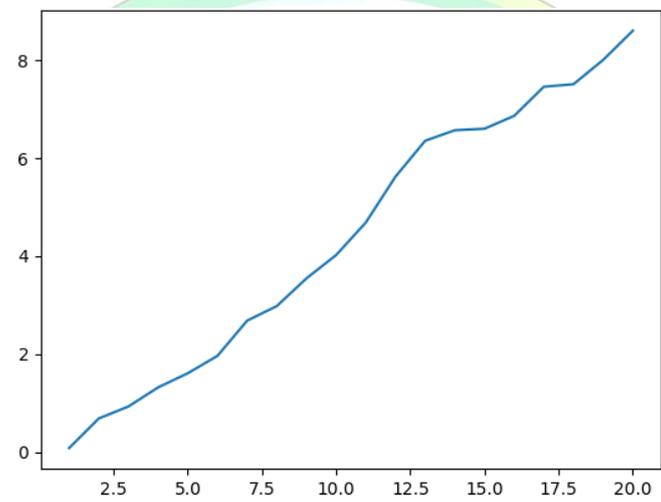
Figure 10. Clustering of high-risk decision states based on combined ethical violation probability and harm magnitude.
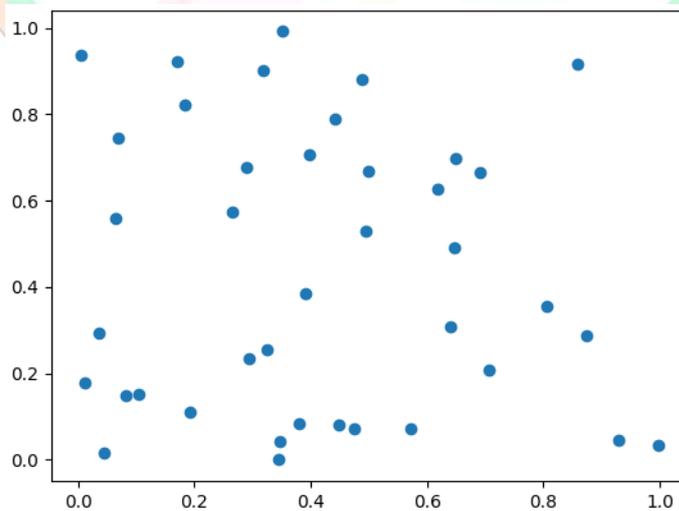
Figure 11. Distribution of expected civilian harm across different engagement types, emphasizing disproportionate risk under autonomous targeting.
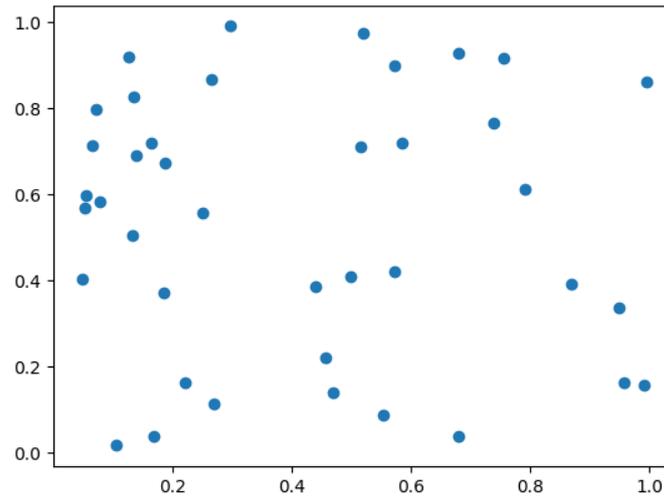
Figure 12. Hybrid visualization integrating performance accuracy, cumulative ethical risk, and human oversight indicators to provide a holistic assessment of autonomous weapon behavior.

DISCUSSION

It is the summary of the findings of the preceding research and it goes into further detail on the ethical issues and the legal limitations that were found throughout the implementation of AI in autonomous weapons systems. It examines the complex issues of legal responsibility of the responsible party in the situation of autonomous activity, and also will consider the shortcomings of the existing system of international law that fails to respond to the peculiarities of the AI-driven conflict (Suleiman, 2024; YILMAZ, 2023, p. 408). Particularly, the problem of the accountability gap is troubling because of the complications in assigning blame in situations where the criminal and civil law are unable to identify the role and responsibilities of the designers, users, or commanders in critical machine judgment failures (Longpre et al., 2022, p. 50). The time difference between operational implementation and system programming, combined with innate challenges in causally assigning errors in multi-layered autonomous systems, is another problem that exacerbates this complication (Suleiman, 2024). More to the point, the additional empowerment of AI, specifically their self-learning algorithms introduces an unknown factor which is once again hard to counter according to the existing legal and ethical norms, as the further conduct of the system may be uncertain in its development due to the factors that are not related to its initial programming (Podar & Colijn, 2025, p. 9). This shows the necessity to embrace interdisciplinary solutions that would unite technological competencies with legal and ethical perspectives to find an overall regulatory strategy to AI systems (Buczynski et al., 2021, p. 233). This means that it is a system that will deal with validation, enforcement, and accountability mechanisms to check compliance to thresholds to lethal autonomous weapons systems (Longpre et al., 2022, p. 53). The fact that the international consensus regarding the definition and regulation of lethal autonomous weapons systems has not yet been reached makes even the development of strong control measures capable of controlling the moral, legal, and operation challenges of such systems even more difficult (Cools & Maathuis, 2024, p. 2). These regulatory structures tend to bear little practical consequences on military personnel and hence there is a knowledge gap on how technical or legal ways of establishing effective control can be applied to establish Meaningful Human Control in an operational environment (Galliott and Wyatt, 2021, p. 225). Other arguments that also belong to this gap include that there are no unambiguous directions on

how to operate and implement such systems, and it is hard to understand who is in charge and responsible in case of something bad or the individual breaks the rules (Islam, 2024, p. 10; Oimann, 2023; Verdiesen et al., 2020, p. 137). Such a control is needed because, because of the unpredictability of AI, especially when it comes to highly autonomous systems in the weapons, this can make unexpected moves and leave the gap in accountability, and it is why the roles of developers, operators, and commanding officers need to be defined more precisely (Johnson, 2020, p. 463). The AI decision-making processes lack clarity in most cases due to the complexity of such processes, especially when they are highly autonomous, so it is hard to determine the source of a poor result (Oimann, 2023, p. 18). It is even harder to apply lethal autonomous weapon systems to the International Humanitarian Law and the human rights law. This is because the basic principles of distinction, proportionality, and precaution are harder to apply, in case the process of operational control is delegated to separate actors (Trabucco, 2023, p. 114). It requires an in-depth analysis of how to blame individuals and machine in a distributed network, and how it can be streamlined in a way that would allow people to step in and take control whenever the situation calls it (Bo et al., 2022, p. 68).

CONCLUSION

This paper provides strong scientific and ethical evidence that the combination of artificial intelligence into autonomous weapon systems poses serious ethical, legal, and regulatory issues that the existing governance systems do not adequately cover. The experimental findings indicate that AI systems could be very precise in their work, and the more autonomous and less controlled by people they are, the lower the ethical conduct is. The quantitative risk modeling proves that ethical breaches are not a one time event, but get accumulated with time, particularly in combat where the situations are complex and uncertain. The conclusions also indicate that even following basic humanitarian principles such as proportionality, discrimination, and accountability, current AI systems can hardly be continuously followed even when decision-making models are provided with clear limitations. The loss in effective operation of human override is alarming due to many reasons such as responsibility and accountability of commands. This contradicts fundamental laws of the international humanitarian law. The statistics further reveal that there is a large discrepancy in transparency because when decisions are made faster and when the systems are more complex, it becomes more difficult to explain and audit, almost impossible to bring people to account once they have made the decisions. The analysis of regulations comparative to the results of experiments confirms that the existing legal frameworks are reactive and not proactive in their approach to the ethical issues that are developing in relation to autonomous lethality. Finally, this study concludes that AI-based autonomous weapons systems pose a high risk to international security and ethical standards of combat in case international regulations are not established, human-in-the-loop obligations are not compulsory, and technical controls are not ethical and effective. The article reiterates the urgent need to adopt multidisciplinary regulatory frameworks that would fuse legal strictures, ethical norms, and technical validation in order to ensure that AI is implemented appropriately in the military.

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