

## ARTICLE

The Irony of the Iron Dome:  
Intelligent Defense Systems, Law, and Security

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### Abstract

International law does not directly address intelligent defense systems (IDSs), of which Israel's Iron Dome embodies the most successful implementation to date. This Article argues that international humanitarian law ("IHL") should encourage the development and use of systems like Iron Dome by conceptualizing such systems as civil defense.

That IHL should incentivize IDSs is not as obvious as it may seem. While incentivizing IDSs would uphold humanitarian law's ultimate purpose (i.e., the protection of civilians), the data suggests that IDS deployment can lead to an increase in rockets and the (re)emergence of violent tactics. IDSs also challenge the prevailing logic of IHL, which is typically focused on protecting the other side and not one's own. But not incentivizing systems like Iron Dome flies in the face of IHL's essence and leads to more casualties.

IHL should choose to incentivize intelligent defense systems for reasons grounded in humanitarian law itself, data analysis on Iron Dome, and offense-defense theory. Ultimately, conceptualizing IDSs as civil defense best addresses the complex legal and security dilemmas arising out of the use of intelligent defense systems.

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## Introduction

The Iron Dome, the defense system used by Israel to counter incoming enemy projectiles, is something of a technological wonder. The system's ability to predict the trajectory of rockets, intercept salvos of rockets of differing sizes, and sustain this activity over long periods of time has left laymen and experts equally stunned. Its operational success, combined with the rapid proliferation of mortars, rockets, and missiles into conflict areas, has generated significant interest on the part of states.<sup>1</sup>

Despite the increased use of defensive systems, international humanitarian law (IHL) does not directly address intelligent defense systems (IDSs).<sup>2</sup> IDSs are neither provided the straightforward protection from attack afforded to civilian objects,<sup>3</sup> nor are they explicitly characterized as legitimate targets. In this Article, we examine the question of whether IHL should encourage the development and use of systems like Iron Dome and, arguing that it should, we offer some thoughts on how intelligent defense systems should be conceptualized under the law.

This will not be the first time that technology-driven developments of modern warfare raise previously untouched questions and challenge well-entrenched legal assumptions. What is surprising, however, is that IDSs have hardly ever been addressed in legal and security studies scholarship even though they have been used in armed conflicts for nearly twenty-five years.

The Iron Dome resembles the Patriot Missile System developed by the United States. The Patriot was originally designed for anti-aircraft purposes but was modified before the First Gulf War to shoot down Iraqi Scud missiles aimed at the civilian population. At the time, Patriot Missile batteries were strategically

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<sup>1</sup> Andrea Shalal-Esa, *Raytheon Sees 'Never-Ending Opportunity' in Patriot Missile System*, REUTERS (Aug. 4, 2013), <http://www.reuters.com/article/us-raytheon-patriot-idUSBRE9740QZ20130805>.

<sup>2</sup> In this Article we identify a new type of defensive technology used during conflict which we coin “intelligent defense system” (IDS). IDS meet specific technological requirements (they must be autonomous, intelligent, and strictly defensive—as explained below) and are deployed for the purpose of protecting civilian populated areas from indiscriminate projectile threats. Systems that share the technological qualifications of IDSs but are not deployed as such (e.g. the Patriot Missile System, used in the First Gulf War to protect troop deployments) do not qualify as IDSs for purposes of this Article. The technological features of IDSs are such that the system can identify incoming projectiles by determining the “polygon”—the area in which a projectile will likely land—and choose whether or not to intercept the projectile if the polygon includes civilian populated areas. IDSs are thus different from other defensive systems like the Phalanx (designed to protect specific military objectives like a ship), the THAAD (designed to protect an entire country from ballistic missile threats), and standard air defense systems (designed to intercept aircrafts, and are thus capable of inflicting enemy casualties as part of the interception process).

<sup>3</sup> Other objects highly valuable to civilians, such as hospitals or religious/cultural property, do enjoy protection.

placed around Israel to protect large portions of the country.<sup>4</sup> Batteries were also placed in Saudi Arabia where they were tasked with protecting American military interests. Thanks to technological advances which vastly improved its disappointing performance in the First Gulf War, the Patriot Missile System was also used in the Second Gulf War, and it is currently operational in many countries.<sup>5</sup>

It took decades before Iron Dome made its entry on the battlefield—first during Operation Pillar of Defense in November 2012 and then during Operation Protective Edge in 2014, with 84% and 91% rates of success, respectively.<sup>6</sup> It was developed by Israel with some financial support from the United States<sup>7</sup> in order to protect civilians from intense rocket attacks launched by Hamas from the Gaza Strip and by Hezbollah from south Lebanon. At the time Israel operationalized the system in 2011, the projectiles in its neighboring enemies' arsenals were predominantly (though not exclusively) short-range crude-rockets, generally less than 70 kilometers, and mortars.<sup>8</sup> These weapons are frequently described as “statistical distribution projectiles”—rockets and mortars that are guided by human calculation (i.e., no guidance system). Such projectiles, in most cases, are not sufficiently accurate to strike specific targets.<sup>9</sup>

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<sup>4</sup> Gordon R. Mitchell, *Placebo Defense: Operation Desert Mirage? The Rhetoric of Patriot Missile Accuracy in the 1991 Persian Gulf War*, 86 *QUARTERLY JOURNAL OF SPEECH* 122 (2000).

<sup>5</sup> Gormley D. M., *Missile Defence Myopia: Lessons from the Iraq War*, 4 *SURVIVAL* 61–86 (2003).

<sup>6</sup> Though the Patriot System has been used in multiple conflicts—both Gulf Wars—the success of the system has been disputed (specifically in the first Gulf War) and these statistics are not readily available (see Mitchell, *supra* note 4). Consequently we draw much of our analysis on the limited data available on the Iron Dome. Mindful that this data is limited, we use it to raise some concerns and awareness about the use of IDSs in contemporary conflicts. The task of learning anything from data is further complicated by the fact that Israel, for security purposes, generally prevented the Israeli media from publishing locations targeted by rockets which they feared might improve enemy accuracy. Both Israel and Hamas had reason to exaggerate or diminish the number of rockets launched, and number of rockets intercepted, depending on audience. Furthermore, in March of 2013, a few select scholars challenged the legitimacy of IDF claims of the Iron Dome's interception rates. Unlike the Patriot Missile Systems used in the first Gulf War, these claims were quickly dismissed as erroneous. Nonetheless, we concede that with the passage of time, with further investigation as well as the declassification of data, a more accurate picture of the Iron Dome's performance will likely emerge.

<sup>7</sup> While most of the funding for the Iron Dome was provided domestically, a substantial amount of funding has come from the United States. A bill was passed to help replenish the stock of interceptors during Operation Protective Edge: H.J. Res. 76. See Rebecca Shimoni Stoil, *Obama approves \$225 million in Iron Dome funding*, *TIMES OF ISRAEL* (Aug. 5, 2014), <http://www.timesofisrael.com/obama-approves-225-million-in-iron-dome-funding/>.

<sup>8</sup> Ethan Bronner, *With Longer Reach, Rockets Bolster Hamas Arsenal*, *N.Y. TIMES* (Nov. 17, 2012), [http://www.nytimes.com/2012/11/18/world/middleeast/arms-with-long-reach-bolster-hama.s.html?\\_r=0](http://www.nytimes.com/2012/11/18/world/middleeast/arms-with-long-reach-bolster-hama.s.html?_r=0).

<sup>9</sup> Over 100 of these projectiles failed to reach Israel during operation Pillar of Defense alone, exploding instead within Gaza. Many others fell harmlessly into the Mediterranean Sea (see Michael J. Armstrong, *Modeling Short-Range Ballistic Missile Defense and Israel's Iron Dome System*, 62 *OPERATIONS RESEARCH* 1031 (2014)).

At the level of theory, conceptualizing intelligent defense systems under IHL is difficult because these systems embody a departure from the law's prevailing logic—a logic focused on regulating harm that can lawfully be *caused* to the other side. In contrast, IHL barely addresses the duties owed by a belligerent to its own people, be they civilians or combatants (we call these “reflexive” duties). The primarily causative nature of IHL makes it difficult to conceptualize a system that is by nature reflexive.<sup>10</sup>

Other and arguably greater hurdles lie ahead. IHL must decide whether it wishes to encourage, promote, and support the development and deployment of IDSs. These systems are often developed in order to protect states from attacks that are at best indiscriminate, and at worst intentionally directed at civilians. The example of the Iron Dome illustrates this point. Had Israel faced a conventional enemy on a conventional battlefield, it probably would not have felt the need to develop the Iron Dome. Intelligent defense systems seek to protect against violations of the law committed by the other side and, as such, rectify a situation caused by IHL's own inability to prevent the commission of these war crimes. The problem is that by encouraging IDSs, the law would acknowledge its own failure to normalize the behavior of non-compliant actors. Moreover, our analysis suggests that incentivizing IDSs could lead to certain types of conflict escalation (other violent tactics to counter the Iron Dome's operational success (re)emerged whenever it was deployed).

Despite these secondary effects, we argue in favor of incentivizing IDSs. This is because IDSs further IHL's primary purpose: protecting civilians from the conduct of hostilities. IDSs actively correct non-compliance by preventing war crimes from materializing and, as the Iron Dome data confirms, actually saving civilian lives on both sides of the conflict. IDSs thus remedy, albeit imperfectly, IHL's failure to promote compliance among non-compliant actors. Incentivizing IDSs is also consistent with insights gained from international relations scholarship, specifically offense-defense theory, which has pointed to the role of defense in promoting international security.<sup>11</sup>

Finally, the alternative of disincentivizing IDSs would directly and tangibly affect civilian lives. Rockets killed on average more Israeli civilians in wars during which the Iron Dome was not deployed—leading to more powerful military responses on the part of Israel in an effort to deter or destroy rocket launches, and therefore also more casualties among Palestinian civilians. It is our view that the use of an IDS and the associated decline in civilian casualties is preferable—even if it may have secondary effects on enemy tactics.

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<sup>10</sup> Questions related to the *jus ad bellum* are beyond the scope of this Article.

<sup>11</sup> Sean M. Lynn-Jones, *Preface*, in *OFFENSE, DEFENSE AND WAR* xi (Michael E. Brown et al. eds., 2004). As noted in Part II (1) below, offense-defense theory contends that “international conflict and war are more likely when offense has the advantage, while peace and cooperation are more probable when defense has the advantage.” See Sean Lynn-Jones, *Offense-Defense Theory and its Critics*, 4 *SEC. STUDIES* 660 (1995).

Incentivizing IDSs could be realized via a much-needed conceptualization of these systems under the law.<sup>12</sup> The systems do not easily fit into the civilian/military dichotomy. This is because of the inherent tension that exists between the systems' humanitarian purpose and their close relationship to the military (they are generally both developed and operated by the military). In light of the foregoing, we argue that the long-forgotten IHL concept of civil defense would better account for the unique role IDSs play on the contemporary battlefield.

### I. IHL in a Bind: Incentivize or Disincentivize IDSs?

To date, IHL has not directly addressed the development or deployment of IDSs in armed conflict. Neither treaty law nor customary law addresses the status of a defensive apparatus. The use of defensive measures for the protection of the civilian population is envisaged only in the context of civil defense (we return to this later). Similarly, international relations scholarship devotes little attention to intelligent defense systems—showing a surprising lack of concern for how they impact international security.<sup>13</sup> Our analysis of IDSs thus begins with a relatively blank slate.

Our initial assertion is that IDSs are a unique and desirable type of technology. Any non-lethal system that protects civilians while reducing the level and scope of destruction should be welcomed and encouraged by IHL. We find, for example, that Iron Dome reduced harm to Israelis and Palestinians in many circumstances.<sup>14</sup>

Yet the benefits of such systems are not without controversy. IDSs can lead to countervailing measures by an enemy that may trigger an escalation of violence, such as the large rocket barrages launched by Hamas to overwhelm the Iron Dome system. In the Cold War context, anti-ballistic missile defense was in fact curtailed in the 1970s for fear that it might lead to an arms race or encourage

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<sup>12</sup> Our position is that law is a tool of policy and does, to variable extents, influence state behavior (in our case both the development and the use of IDSs). While the position taken by the law on IDSs will not affect all belligerents in the same way, our assumption is that it will at least play a part in the decision-making of law-abiding states. It would also matter in post-conflict inquiry—even vis-à-vis non-compliant actors. Even skeptics would agree that any body of law seeks to promote certain behavior and discourage other. This is precisely the question we examine in relation to IHL and intelligent defense systems.

<sup>13</sup> Our work on the impact of intelligent defense systems on international security underscores the common concerns shared by IR and IHL, and the similarity of the challenges they face. That said, we identified important gaps between IR and IHL with respect to the definitions of weapon and civil defense. *See infra* notes 129 and 137.

<sup>14</sup> Our data shows that the Iron Dome, through its interceptions, dramatically lowered the number of Israeli civilian fatalities per rocket fired. We also show that the number of Palestinian civilian fatalities per rocket fired decreased with the introduction of the Iron Dome. Given the role that rocket fire played in instigating the conflicts and the varying lengths of the conflicts (eight days to nearly two months), we feel the use of this measure (civilian fatalities per rocket fired) is more consistent than measuring total fatalities. *See generally* Appendix.

a “first strike” (though the context and nature of the threat was different from that we consider here).<sup>15</sup> Even the Israeli establishment was reluctant to develop Iron Dome due to its high cost and the fear that the enemy would quickly find alternative tactics to neutralize its effectiveness, possibly at higher cost in civilian and military terms.<sup>16</sup>

#### A. *The Primarily Causative Nature of IHL*

Part of IHL’s difficulty in deciding whether to embrace, much less promote, intelligent defense systems lies in the law’s primarily causative nature. IHL focuses on the treatment of a state’s opponents—that is, enemy civilians and, to a lesser extent, enemy combatants:

As IHL developed as the law of international armed conflicts covering, in conformity with the traditional function of international law, inter-State relations, it aimed essentially to protect “enemies” in the sense of enemy nationals.<sup>17</sup>

IHL primarily regulates how belligerents ought to behave vis-à-vis one another in times of war, such as the type of weapons they may use, the level of harm they may inflict, the tactics they may employ, and whom they must spare. In other words, IHL regulates the type and level of harm that can be *caused* to the enemy or its civilians.

IHL’s focus on causative factors is a function of its history and evolution. Traditionally understood as the body of law governing state conduct in a time of war, IHL protects enemy civilians from hostilities and authorizes the targeting of combatants in armed conflicts. IHL also makes clear that war is not unlimited by restricting the type and level of harm that can be inflicted on the other side in order to achieve victory.

The concept of limited war grew in importance as the laws of war developed. In 1863, the Lieber Code made clear that “no conventional restriction of the modes adopted to injure the enemy is any longer admitted; but the law of war imposes many limitations and restrictions on principles of justice, faith, and

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<sup>15</sup> See The Anti-Ballistic Missile (“ABM”) Treaty, May 26, 1972, U.S.-U.S.S.R., 23 U.S.T. 3435, 944 U.N.T.S. 13. We reject, however, the parallel between IDSs and ABMs due to the many substantive differences between them. Nuclear-armed missiles constitute a strategic, first-strike capability whose devastation would be catastrophic to a population and region. Limiting ABMs in the context of Cold War deterrence is distinguishable to the specific circumstances of the U.S.-Soviet balance of power—no nuclear weapons were fired in battle during the half-century of the Cold War. These are far different from tactical projectiles such as the thousands that have in fact been fired by Hamas and intercepted by Iron Dome.

<sup>16</sup> Yiftah S. Shapir, *Rocket Warfare in Operation Protective Edge*, in 43 LESSONS OF OPERATION PROTECTIVE EDGE 48 (Anat Kurz and Shlomo Brom eds., 2014).

<sup>17</sup> See MARCO SASSÒLI ET AL., *HOW DOES LAW PROTECT IN WAR?* 32 (3d ed. 2011).



honor.”<sup>18</sup> These ideas were later reaffirmed in the St. Petersburg Declaration of 1868<sup>19</sup>—the first international agreement limiting what states can do in war—and in Article 22 of the 1907 Hague Regulations: “The right of belligerents to adopt means of injuring the enemy is not unlimited.”<sup>20</sup> In contemporary IHL, a plethora of norms give expression to this concern for the other side—from prisoner of war status to advance warning, proportionality, distinction, and unnecessary suffering.

Few norms of IHL, however, dictate how belligerents ought to treat their own people in times of war, whether civilians or combatants. We call these norms reflexive norms. Examples of reflexive norms include those governing non-international armed conflict. In non-international armed conflicts, the concept of direct participation in hostilities takes on reflexive undertones: it regulates the targeting of a state’s own nationals who have taken up arms against governmental forces, pursuant to the limitations imposed by Article 51(3) of Additional Protocol I.<sup>21</sup> Similarly, rules governing the identification of hospitals and civil defense teams qualify as reflexive as they impose norms on states for the purpose of protecting their own population. The same could be said about Article 58 of Additional Protocol I,<sup>22</sup> which imposes a triple duty on states to protect their own civilian population from the effects of attacks.<sup>23</sup> The principle of distinction, for its part, combines causative and reflexive concerns. It gives expression to causative concerns in that it requires military commanders to direct strikes at military targets only (in order to minimize the harm caused to enemy civilians). But it is also a reflexive norm in the sense that it requires members of the armed forces to identify themselves in order to ensure the protection of their own civilian brothers.

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<sup>18</sup> U.S. Dep’t of War, Headquarters, Gen. Orders No. 100, art. 30 (Apr. 24, 1863) (emphasis added).

<sup>19</sup> Declaration Renouncing the Use, in Time of War, of Explosive Projectiles Under 400 Grammes Weight, (Nov. 29/Dec. 11, 1868), <http://www.state.gov/t/avc/trty/101888.htm#narrative>.

<sup>20</sup> Convention (IV) respecting the Laws and Customs of War on Land and its annex: Regulations concerning the Laws and Customs of War on Land, Oct. 18, 1907, 36 Stat. 2227, T.S. No. 539.

<sup>21</sup> Protocol Additional (I) to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts (Protocol I), June 8, 1977, art. 51(3) 1125 U.N.T.S. 3 [hereinafter “AP I”].

<sup>22</sup> *Id.*, art. 58.

<sup>23</sup> See Yves Sandoz, Christophe Swinarski, and Bruno Zimmerman, COMMENTARY ON THE ADDITIONAL PROTOCOLS OF 8 JUNE 1977 TO THE GENEVA CONVENTIONS OF 12 AUGUST 1949 (ICRC, 1987) [hereinafter “ICRC Commentary”], para. 2244 (“[I]t is in their own interest that States should take such measures.”) and para. 2239 (noting that Article 58 “is not concerned with laying down rules for the conduct to be observed in attacks on territory under the control of the adversary, but with measures which every Power must take in its own territory in favour of its nationals, or in territory under its control.”). Article 58 reads as follows: “The Parties to the conflict shall, to the maximum extent feasible: (a) without prejudice to Article 49 of the Fourth [Geneva] Convention, endeavour to remove the civilian population, individual civilians and civilian objects under their control from the vicinity of military objectives; (b) avoid locating military objectives within or near densely populated areas; (c) take the other necessary precautions to protect the civilian population, individual civilians and civilian objects under their control against the dangers resulting from military operations.”

Although reflexive considerations were at best of secondary importance at the time of IHL's inception<sup>24</sup> (and have remained much less developed to this day), there is nothing inherently wrong with a predominately harm-focused approach. IHL should be concerned with the harm inflicted on enemy civilians and combatants by a state party. But the under-theorization of "reflexive duties" has shown its limits, in areas as varied as the rights of combatants, the legality of targeting one's own nationals, or the duties owed to one's population during armed conflict.

The question of the rights owed by a state to its own forces arises, for example, when the state must choose between an aerial attack (likely to limit losses among one's own forces) and a ground attack (which puts one's combatants in harm's way but potentially limits collateral damage to enemy civilians and infrastructure). Though the state might be able to spare civilian life with a ground attack, the losses to its own forces might be significantly higher than with an aerial attack. Asa Kasher was among the first to point to IHL's indifference vis-à-vis combatants' lives: "Much less attention has been paid to the idea of regarding, during an armed conflict, every person in military uniform of an enemy state as a legitimate target for attack."<sup>25</sup> Kasher not only criticizes the widely accepted view that combatants can lawfully be killed regardless of the military advantages ensuing from their deaths, he also questions the level of harm in which one's own combatants may be placed in order to spare enemy civilians.<sup>26</sup> A consensus has yet to emerge on this question.<sup>27</sup> Some legal scholars argue that the proportionality calculus accounts for harm caused to one's own armed forces as part of the assessment of military advantage.<sup>28</sup> Others view this as an external consideration not fully accounted for in the *lex lata*.<sup>29</sup>

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<sup>24</sup> For a different view, see Eyal Benvenisti and Amichai Cohen, *War is Governance: Explaining the Logic of the Laws of War from a Principal-Agent Perspective*, 112 MICH. L. REV. 1363, 1371 (2014) (noting that "IHL reflects domestic principals' attempts to create an effective means of monitoring and disciplining their agents.").

<sup>25</sup> Asa Kasher, *Combatants' Life and Human Dignity*, 24 ISRAEL YEARBOOK ON HUMAN RIGHTS 220, <http://www.humanrightsvoices.org/site/documents/?d=13577>. See also Asa Kasher and Amos Yadlin, *Assassination and Preventive Killing*, 25 SAIS REV. OF INT'L AFF. 41 (2005).

<sup>26</sup> *Id.* at 25. See also Avishai Margalit and Michael Walzer, *Israel: Civilians & Combatants*, THE NEW YORK REV. OF BOOKS (May 14, 2009), <http://www.nybooks.com/articles/2009/05/14/israel-civilians-combatants/> (replying to Kasher and Yadlin, *Assassination and Preventive Killing*, 25 SAIS REV. OF INT'L AFF. 41 (2005); and Jeff McMahan, *KILLING IN WAR* 51S (OUP, 2009) (addressing the "boxing match model of war"—where the moral justification of why combatants are targetable rests on their consent to being killed).

<sup>27</sup> See *Smith (No.2) v. The Ministry of Defence* [2013] UKSC 41 (Eng.) (the claimants argued that the state owes its soldiers a general duty of care to take appropriate measures to secure their safety. The U.K. Supreme Court rejected the claim). We are indebted to Ruvi Ziegler for this point.

<sup>28</sup> See Iddo Porat & Ziv Bohrer, *Preferring One's Own Civilians: May Soldiers Endanger Enemy Civilians More than They Would Endanger Their State's Civilians?*, 47 GEO. WASH. INT'L L. REV. 99, 108–09 (2015).

<sup>29</sup> For a discussion of this issue, see Gabriella Blum, *The Dispensable Lives of Soldiers*, 2 J. OF LEGAL ANALYSIS 69, 115 (2010).

We attribute the uncertainty as to the scope of a combatant's rights to the law's focus on causative obligations, at the expense of reflexive obligations. Article 35(2) of Additional Protocol I constitutes one of the rare instances in which the laws of war address the rights of combatants.<sup>30</sup> It prohibits the use of weapons, projectiles, and material and methods of warfare of a nature likely to cause superfluous injury or unnecessary suffering.<sup>31</sup> Importantly, Article 35(2) is commonly interpreted as protecting enemy combatants (a causative concern) and not one's own combatants (a reflexive concern).<sup>32</sup>

IHL not only provides little guidance on a state's obligation to protect its own forces, but also fails to address the circumstances in which a state may target its own nationals in international armed conflicts. It does contemplate, to some extent, a situation where a state's governmental forces might have to fight rebels within that state's territory. In such situations, the concept of direct participation in hostilities provides an answer by authorizing the targeting of one's civilians for such time as they take a direct part in hostilities.<sup>33</sup> Yet the question of when, and under what circumstances, states can target their own nationals abroad remains a delicate reflexive question that has generated heavy legal and political debate in the United States.

This question arose during the 2011 targeting of U.S. national Anwar al-Awlaki in Yemen. Anwar al-Awlaki was American born, but moved back to Yemen with his family at the age of seven, returning to the U.S. for college and graduate education. He was in contact with three of the 9/11 hijackers. U.S. drones killed al-Awlaki on September 30, 2011. The U.S. government provided only piecemeal legal justifications for the killing—leading to months of speculation until the legal memorandum authorizing al-Awlaki's targeting was finally released in 2014.<sup>34</sup> The legal memorandum aptly acknowledges that “[t]here is no precedent directly addressing the question in circumstances such as

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<sup>30</sup> AP I, *supra* note 21, art. 35(2). Formerly Article 23(e) of the Hague Regulations of 1907. For another rare discussion of the rights of combatants, see *Legality of the Threat or Use of Nuclear Weapons*, Advisory Opinion, I.C.J. Reports 1996, para. 78 (noting that the principle prohibits causing unnecessary suffering to combatants). Prisoner of war status is another exception to the rather thin treatment of combatants' rights in the law.

<sup>31</sup> For a history of the provision, see YORAM DINSTEIN, *THE CONDUCT OF HOSTILITIES* 58–61 (2d ed. 2007).

<sup>32</sup> ICRC Commentary, *supra* note 23, para. 1416.

<sup>33</sup> AP I, *supra* note 21, art. 51(3).

<sup>34</sup> U.S. Dep't of Justice, Office of Legal Counsel, Memorandum for the Attorney General Regarding the Applicability of Federal Criminal Laws and the Constitution to Contemplated Lethal Operations against Shaykh Anwar al-Aulaqi (July 16, 2010), <https://www.aclu.org/foia-document/memorandum-attorney-general-re-applicability-federal-criminal-laws-and-constitution> (importantly, the memorandum noted that the operation formed part of the non-international armed conflict between the U.S and al-Qaida, at 24). A previous DOJ white paper had been published by NBC on Feb. 4, 2013 (“Lawfulness of a Lethal Operation Directed Against a U.S. Citizen Who is a Senior Operational Leader of Al-Qa’ida or an Associated Force”).

those present here.”<sup>35</sup> The complexity of this issue, coupled with the lack of guidance provided by IHL, lies, in large part, in this body of law’s predominantly causative approach.

For similar reasons, IHL also fails to address situations where a state targets its own innocent civilians. In such cases the concept of direct participation in hostilities does not help, as the civilians have not lost their immunity. Take, for example, the intentional targeting by a state leader of its own nationals or the use, by a belligerent, of its own civilians as human shields. IHL—unlike human rights law or international criminal law—does not directly address the question of a belligerents’ responsibility for the harm caused to its own civilians.

We postulate that modern warfare will generate many more of such reflexive dilemmas in the future. The contemporary battlefield is not the open landscapes of Waterloo or World War II; it coincides with urban centers where combatants operate and hide among civilians. The use of tunnels to hide, launch attacks, and store ammunition also raises an array of reflexive concerns.<sup>36</sup> Tunnel warfare places one’s own combatants directly in harm’s way—bringing Asa Kasher’s dilemma of the value of combatants’ lives to another level.<sup>37</sup> And states might consider evacuating their nationals<sup>38</sup> or destroying their own civilian infrastructure in order to destroy existing tunnels.<sup>39</sup>

Intelligent defense systems, too, require IHL to stretch beyond its primarily causative nature. IDSs mainly raise questions relating to a state’s obligations vis-à-vis its own civilians, such as whether states are under an obligation to deploy defensive weapons to protect their civilian populations during armed conflict. This very question came before the Israeli Supreme Court in August 2011.<sup>40</sup> Representatives of towns and villages located within 4.5 kilometers of the Gaza border demanded that the Israeli government deploy the

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<sup>35</sup> Memorandum, *supra* note 34, at 22. The legal memorandum makes an analogy between detention and targeting. Since the U.S. Supreme Court authorized the detention of a U.S. national member of the Taliban abroad in *Hamdi v. Rumsfeld*, 542 U.S. 507 (2004), the memo concluded that “just as the [Authorization for the Use of Military Force, the statute authorizing the United States to use force against members of Al Qaeda and affiliated forces] authorizes the military detention of a U.S. citizen captured abroad who is part of an armed force within the scope of the AUMF, it also authorizes the use of ‘necessary and appropriate’ lethal force against a U.S. citizen who has joined such an armed force.” *Id.* at 23.

<sup>36</sup> See generally Benjamin Runkle, *Preparing for Warfare’s Subterranean Future*, WAR ON THE ROCKS (Apr. 16, 2015), <http://warontherocks.com/2015/04/preparing-for-warfares-subterranean-future/>.

<sup>37</sup> In the case of tunnels located in or near civilian populated areas, states would have to choose between aerial attacks likely to cause many civilian casualties and a ground operation which would entail entering the tunnels and placing the soldiers in a great deal of danger.

<sup>38</sup> HUMAN RIGHTS WATCH, *LOOKING FOR ANOTHER HOMELAND* (Sept. 22, 2015), <https://www.hrw.org/es/node/281280>.

<sup>39</sup> *Egypt to Deepen Buffer Zone With Gaza After Finding Longer Tunnels*, REUTERS (Nov. 17, 2014), <http://www.reuters.com/article/us-egypt-sinai-buffer-idUSKCN0J11M920141117>.

<sup>40</sup> HCJ 8013/10, *Eshkol Regional Council v. Prime Minister*, NEVO (Aug. 8, 2011).

Iron Dome in the area. The Court discarded the position that the government had to ensure the protection, at all times, of all Israeli citizens from any security threat—whether based on a prior commitment or on grounds of fairness.<sup>41</sup> The Court held that the decision whether or not to deploy Iron Dome falls within the government's discretionary power to make operational decisions in concert with the military.<sup>42</sup>

Except perhaps for the much-undertheorized Article 58(c) of Additional Protocol I, international law would have added little to this debate. As discussed at length in Part I, IHL does not address defense systems, let alone the reflexive dilemmas that may arise out of their development and use. It is not surprising, therefore, that both the petitioners and the court left international law out of the discussion. One might argue that IHL should not intervene in how a state interacts with its own citizens, that constitutional law is better equipped to address reflexive issues than IHL. One might also argue that these situations should be governed by human rights law under the *lex specialis* doctrine. It would be challenging, politically if not legally, to recognize a human right to protection allowing nationals to compel states to take measures such as the deployment of an IDS. Petitioners before the Israeli Supreme Court did not rely on human rights law—but the Court's analysis suggests that arguments to this effect would likely have been rejected.

While some may argue that reflexive questions fall outside the ambit of IHL, these questions will continue to arise in the context of asymmetric warfare. Waging war is nowadays guided by our own values and principles rather than by those of non-compliant enemies. States have made it clear,<sup>43</sup> and a consensus has emerged, that IHL constitutes a set of unilateral undertakings not subject to reciprocity.<sup>44</sup> In this context, issues surrounding a state's treatment of its own nationals—be they civilians or combatants—will only intensify. Though these dilemmas arise sporadically and in seemingly unrelated contexts, they share a common root: IHL's primarily causative approach. In light of the foregoing, it is unsurprising that IHL would find it difficult to rationalize and conceptualize IDSs, whose purpose is inherently reflexive.

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<sup>41</sup> *Id.*, para. 15. The Court also rejected arguments to the effect that the government's decision infringes upon the petitioners' right to the protection of body and life—arguably protected under Israel's constitution (see paras. 4 and 18).

<sup>42</sup> *Id.*, para. 24.

<sup>43</sup> See, e.g., President Obama, Nobel Peace Prize Acceptance Speech (Dec. 10, 2009), <https://www.whitehouse.gov/the-press-office/remarks-president-acceptance-nobel-peace-prize>; President François Hollande (France), Speech given in Mali (Feb. 2, 2013), <http://ambafrance-us.org/spip.php?article4310>.

<sup>44</sup> See Daphné Richemond-Barak, *Applicability and Application of the Laws of War to Modern Conflict*, 23 FLA. J. INT'L L. 327, 336–37 (2011).

### B. *The Asymmetric Escalation Paradox*

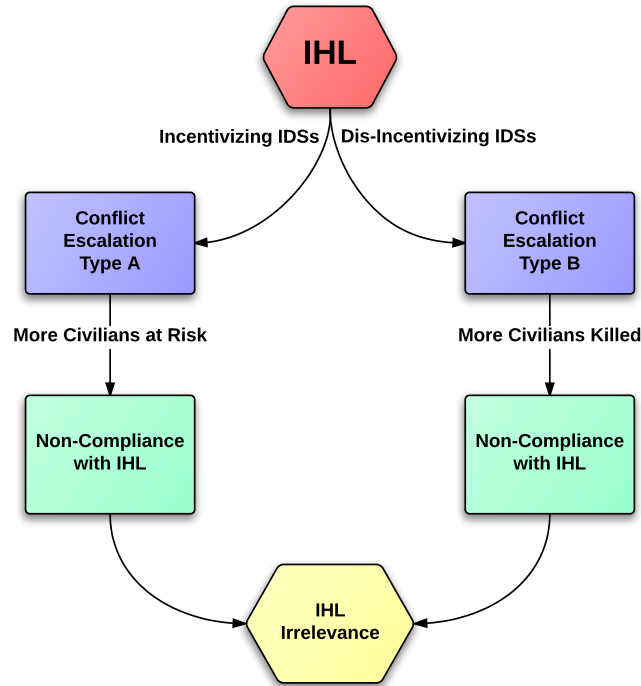
There is another reason why IHL has not taken a clearer stance vis-à-vis IDSs. These systems are designed to uphold IHL's core values and remedy violations committed by enemy belligerents. Yet the development and use of IDSs also highlights IHL's failure to normalize enemy behavior in asymmetric warfare. By encouraging the use of defense systems, IHL implicitly abdicates responsibility for the non-compliant behavior of these actors and fails to discourage non-compliant behavior in the future. Even more problematic, our data on the Iron Dome suggests that the use of an intelligent defense system leads to certain forms of conflict escalation.<sup>45</sup> The question is whether IHL should encourage the use of IDSs, given the implications for IHL legitimacy and the likely escalation of violence.<sup>46</sup>

We have coined this serious and ironic phenomenon the Asymmetric Escalation Paradox. It refers to the precarious and vulnerable position that the law finds itself in as a result of the use of IDSs in armed conflict: whether IHL chooses to incentivize or disincentivize IDSs, it will not succeed in creating conditions guaranteeing IHL compliance and its humanitarian essence. Absent an IDS, more civilians will die and IHL will lose credibility for failing to create incentives to comply with the law (Conflict Escalation Type B, see the diagram below). But the use of an IDS affects the conflict in other, significant ways: more violence will be used to overcome the defensive apparatus—violence which IHL will once again fail to prevent or deter (Conflict Escalation Type A in the diagram below).

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<sup>45</sup> The term “conflict escalation” has various meanings and encompasses multiple variables. For example, a conflict may escalate if there is a significant increase in the number of rockets fired into civilian areas. We consider this a specific escalation regardless of whether it results in increased casualties. Nonetheless casualties, too, are important when determining conflict escalation, as are the number of people threatened or adversely affected by warfare. We do not attempt to define conflict escalation here, certainly not quantitatively, but have provided data in the following pages that highlight some of our qualitative conclusions. We add that “conflict escalation” in the context of this Article is not to be confused with other uses of the term which typically refer to the escalation of a conflict from, for example, a militarized dispute to a full blown war. See, e.g., Karen A. Rasler and William R. Thompson, *Contested Territory, Strategic Rivalries, and Conflict Escalation*, 50 INT'L STUD. Q. 145 (2006). The data included in the attached Appendix has multiple variables related to conflict escalation: Duration of Conflict, Total Rockets Launched, Rockets per Day, Rocket Accuracy, Rockets Targeting Populace, Rocket Distances, Total Israeli Fatalities, Israeli Civilian Rocket Fatalities, Rockets per Israeli Civilian Fatality, Total Opposition Fatalities, Opposition Civilian Fatalities, Rockets per Opposition Civilian Fatality, Opposition Fatalities per Day, Opposition Civilian Fatalities per Day, Total Iron Dome Interceptions, Iron Dome Interception Percentage. We do not assume or argue that these variables are exclusively causal to the implementation of the Iron Dome. However, a qualitative review of the data reveals the following trends are attributable, at least partially, to the deployment of the Iron Dome on the battlefield.

<sup>46</sup> See *supra* note 15.



Conflict escalation is the product of individual, measurable threats. Whether a conflict actually escalates is dependent on how one weighs each individual threat. As the case of Iron Dome illustrates, IHL must choose between two types of escalation: Conflict Escalation Type A (more civilians at risk and the emergence or reemergence of violent tactics), and Conflict Escalation Type B (more civilians killed). It is our view that certain individual conflict components are more important than others (e.g., the total amount of rockets launched is less important than the number of Israeli civilian fatalities caused by these rockets). For this reason, we argue that IHL should create incentives for the use of intelligent defense systems: Conflict Escalation Type A is, in our view, preferable to Conflict Escalation Type B. Those who discount IDSs because of the likelihood of Conflict Escalation Type A do a disservice to conflict analysis and the role of IDSs in a conflict.

We use Israel's implementation of the Iron Dome during Operations Protective Edge (2014) and Pillar of Defense (2012)<sup>47</sup>—particularly as contrasted with Operation Cast Lead of 2008—to explain the Asymmetric Escalation Paradox. While the Iron Dome was deployed in Protective Edge and Pillar of Defense, it was not yet operational during Cast Lead. The main insights gained from the data can be summarized as follows:<sup>48</sup>

<sup>47</sup> Both operations were led by Israel against Hamas. The data from the Second Lebanon War (2006) is included here for reference purposes only.

<sup>48</sup> For a full account of the data, see Appendix Table.

First, conflicts where the Iron Dome was deployed show a mammoth increase in the average number of rockets fired into Israel per day. Second, we notice a significant increase in the rockets' range in these conflicts. Third, despite significant increases in the number of rockets fired and the range of said rockets, fewer rockets actually landed in populated areas when the Iron Dome was in place. This can be attributed to the success of the Iron Dome in intercepting rockets, as well as the decreased accuracy of Hamas rockets (particularly during Operation Protective Edge<sup>49</sup>). Fourth, the average number of rockets necessary to cause a single Israeli civilian fatality jumped substantially with the implementation of the Iron Dome. Fifth, both the number of rockets per Palestinian civilian fatality and daily average of total Palestinian casualties dropped considerably with the introduction of the Iron Dome. However, the daily average of Palestinian civilian casualties increased in conflicts using the Iron Dome.<sup>50</sup>

A closer look at the figures helps assess the system's impact on the behavior of both parties. During Operation Pillar of Defense, the Iron Dome successfully intercepted around 84% of rockets and mortars it engaged. During the first part of Operation Protective Edge, the Iron Dome successfully intercepted over 91% of rockets and mortars it engaged. Consequently, the Iron Dome succeeded in significantly decreasing the number of casualties per Palestinian rocket fired during Operations Pillar of Defense and Protective Edge, as compared to Operation Cast Lead.

The Iron Dome thus had the effect of decreasing the "value" of Hamas rockets. We argue that this, in turn, led Hamas to greatly increase the average daily projectile fire. Hamas tried launching rockets in large salvos,<sup>51</sup> sometimes 10–15 at a time targeting the same location, in order to overwhelm the operational capability of the Iron Dome.<sup>52</sup> While Operation Cast Lead saw an average of 30

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<sup>49</sup> Scholars have found that Hamas developed rocket that extend range at the expense of accuracy and size of warhead. See Udi Dekel, *Operation Protective Edge: Strategic and Tactical Asymmetry*, in 13 LESSONS OF OPERATION PROTECTIVE EDGE 16 (Anat Kurz and Shlomo Brom eds., 2014).

<sup>50</sup> This is largely the result of the ground campaigns.

<sup>51</sup> This strategy was not exhibited as frequently in Operation Cast Lead, during which the Iron Dome was not deployed.

<sup>52</sup> Such conflict escalation could arguably be attributed to Hamas' increased capabilities—rather than to Iron Dome. Hamas' rocket arsenal has grown significantly in both quantity and sophistication since 2005. However, increased Hamas' capability alone does not explain the tactical choices made by the group during the three recent conflicts with Israel. While Israel destroyed the majority of Hamas' "longer-range" rockets in each conflict, particularly in Operation Pillar of Defense and Operation Protective Edge, Hamas did not come close to running out of rockets in any operation. The increase in rocket fire seemed to correspond with the number of interception made by the Iron Dome in an attempt to maintain the number of casualties caused by rockets. Furthermore, certain attacks such as the bombing of a bus in Tel Aviv at the end of Operation Pillar of Defense or the use of tunnels in Operation Protective Edge have been available to Hamas throughout all three conflicts. It is far more likely that, like the resort to suicide bombings and tunnel warfare, the alteration of rocket trajectory and increase in rocket salvos,



projectiles per day launched at Israel, Operation Pillar of Defense saw an average of 188.25 per day and Operation Protective Edge saw an average of 90 per day.<sup>53</sup> These post-Iron Dome deployment figures are significantly higher and, as we explain below, indicative of new tactics employed by Hamas to counter the Iron Dome.<sup>54</sup>

Evidence suggests that this tactic was not successful in defeating the Iron Dome. The average number of rockets necessary to cause a single Israeli civilian fatality increased dramatically from 220 in Operation Cast Lead to 301.20 in Operation Pillar of Defense and 2,250 in Operation Protective Edge. During Operation Protective Edge, Hamas also launched rockets at lower trajectories in order to give Iron Dome interceptors less time and space to successfully destroy their target. But this, too, failed to provide Hamas an advantage over Iron Dome as interception rates actually increased in comparison to prior conflicts.

The data suggests that Hamas sought to undermine the protection offered by the Iron Dome to Israel's population by increasing both the number of rockets fired and the range of these rockets. In 2008, during Operation Cast Lead, Hamas rockets were only able to reach 25 miles into Israel. While this still put heavily populated areas like Beersheba and Ashdod within range, the major metropolitan areas of Tel Aviv, Haifa, Jerusalem and Eilat were beyond Hamas' capability. In Operation Pillar of Defense, Hamas was able to target Tel Aviv and the southern city of Eilat on multiple occasions—thereby increasing its range to nearly 50 miles from the Gaza Strip. During Operation Protective Edge in 2014, rockets with a 90-mile range put more than 80% of the country within Hamas striking reach (the areas out of range have very little population or targets of interest for Hamas). Salvos of rockets targeted Tel Aviv and Jerusalem. One rocket even struck Hadera, a city located over 70 miles north of Gaza and some 30 miles north of Tel Aviv. This newfound ability to target the North of Israel means that nearly

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resulted from Israel's implementation of the Iron Dome. This, incidentally, has consistently come up in discussions with Israeli security experts who have requested to remain anonymous.

<sup>53</sup> Operation Protective Edge had numerous short-lived and failed ceasefires that resulted in pauses in Hamas rocket fire. Without these gaps, both the total amount of rockets and the daily average would have been substantially higher, potentially at the rates of Operation Pillar of Defense. The first cease-fire occurred on July 15, 2014 and was breached quickly. The second cease-fire occurred on July 25, for 12 hours. This was followed by a proposed cease-fire on July 28 that was never carried out. An August 1 cease-fire that was intended to last 24 hours was violated almost immediately by Hamas leading to global condemnation. On August 4, a 72 hour ceasefire went into place. August 10–12 saw a lull in hostilities related to ongoing negotiations with Egypt as a mediator; this lull was extended for five more days until August 18. The conflict official ended on August 26, 2014. See ISRAEL MINISTRY OF FOREIGN AFFAIRS, *THE 2014 GAZA CONFLICT: FACTUAL AND LEGAL ASPECTS*, Chapter III (2015) [http://mfa.gov.il/ProtectiveEdge/Documents/Objectives\\_Phases\\_Operation.pdf](http://mfa.gov.il/ProtectiveEdge/Documents/Objectives_Phases_Operation.pdf).

<sup>54</sup> See Appendix, Iron Dome Armed Conflict Data.

all Israelis now face the threat of Hamas rockets—a problem no longer exclusive to Israel’s southern fringe cities and villages.<sup>55</sup>

Greater range, however, does not always result in greater accuracy. When comparing the accuracy of Hamas rockets during Operation Cast Lead (30%) with Operation Pillar of Defense (32%), we see no generalizable or significant change. Yet rocket accuracy did decrease substantially during Operation Protective Edge (20%), demonstrating that Hamas has tended to favor inaccurate longer-range rockets, even those with smaller payloads, to add fuel capacity and increase fuel efficiency. As a result, Operation Protective Edge saw significantly less rocket damage than prior conflicts.<sup>56</sup>

The data further illustrates this conclusion. In 2008, an average of 9 rockets hit Israel’s populated areas<sup>57</sup> per day. In 2012, this number fell to 7.25, falling even further during in 2014 to 4.5 per day. Hamas did have greater results using short-range mortar attacks, which resulted in the remaining five civilian deaths from projectiles in Operation Protective Edge. Their smaller size and shorter flight path make them significantly harder for the Iron Dome to intercept.<sup>58</sup>

While Hamas’ strategy was not successful in increasing physical damage and civilian casualties, it had more serious economic repercussions for Israel. For example, flights were cancelled after a rocket landed close to Israel’s largest international airport.<sup>59</sup> The targeting of all of Israel’s metropolitan areas also resulted in significant losses for the tourism industry in the height of the summer season. Hamas understood how prolonged rocket fire placing larger parts of the country under threat could be exploited to exercise economic pressure and increase the perception of insecurity—even if the Iron Dome was largely successful in preventing these rockets from inflicting significant death and injury.

The data measuring the impact of Iron Dome on the Palestinian population also shows varying results. The number of Hamas rockets fired per Palestinian civilian fatality increased with the deployment of the Iron Dome. Furthermore, total Palestinian fatalities per day (civilian and non-civilians) decreased from 53 prior to the Iron Dome’s use, to 39.15 thereafter.<sup>60</sup> Palestinian civilian casualties

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<sup>55</sup> See Appendix, Rocket Accuracy.

<sup>56</sup> Shapir, *supra* note 16, at 44.

<sup>57</sup> The Iron Dome is programmed to intercept rockets over populated areas. Rockets threatening to land in unpopulated areas are not intercepted. Populated areas are simply defined as locations where civilians reside.

<sup>58</sup> See Appendix, Rocket Distances.

<sup>59</sup> Grant Martin, *Flights Canceled into Israel’s Ben Gurion International Airport as Rockets Fall Nearby*, FORBES (July 22, 2014), <http://www.forbes.com/sites/grantmartin/2014/07/22/flights-canceled-into-israels-ben-gurion-international-airport-as-rocket-falls-nearby/>.

<sup>60</sup> See Appendix, Opposition Fatalities Per Day.

per day, however, increased from 17.09 to 23.62 in the conflicts in which the Iron Dome was deployed.<sup>61</sup>

The possible relationship between the presence of the Iron Dome and the escalation of the violence in various forms cannot be ignored: as users of IDSs further strengthen their technological advantage, non-compliant belligerents find it easier to rationalize violations of IHL as the only way to redress technological discrepancies.<sup>62</sup>

Hamas also attempted to redress conflict inequality by reverting to alternative, more traditional methods of warfare.<sup>63</sup> During the last day of Pillar of Defense, a public bus exploded in Tel Aviv—the first incident of this type in many years.<sup>64</sup> Kidnappings, of both soldiers and civilians, also figure prominently among Hamas’ tactics.<sup>65</sup> Finally, Hamas invested heavily in building tunnels reaching into Israeli territory. Unable to inflict substantial damage through the air, Hamas went underground in the hope of inflicting Israeli casualties.<sup>66</sup> Though tunnels between Gaza and Israel existed prior to the deployment of Iron Dome, Israel discovered an elaborate network of cross-border tunnels in the summer of 2014 whose scope and deadly potential were unprecedented. It was these tunnels, combined with Israel’s ground incursion to root them out, rather than the number of rockets launched, that resulted in the large number of Israeli casualties during Operation Protective Edge.<sup>67</sup> In fact, the destruction of rocket and rocket launchers was described by the Israeli administration as only one of the goals of the operation, whereas this had been the primary goal of prior operations.<sup>68</sup>

The above changes also affected Israel’s tactics and overall strategy. The Iron Dome provided Israeli leadership greater flexibility in responding to Hamas

<sup>61</sup> See Appendix, Opposition Civilian Fatalities Per Day.

<sup>62</sup> Michael Isikoff, *Hamas Leader: Don’t Compare Us to ISIL* (Aug. 22, 2014), <http://news.yahoo.com/hamas-leader--don-t-compare-us-to-isil-193125056.html>.

<sup>63</sup> See Rami Amichai, *Tel Aviv Bus Hit By Bomb; Hamas Celebrates*, REUTERS (Nov. 21, 2012), <http://www.reuters.com/article/us-israel-telaviv-bus-explosion-idUSBRE8AK0HS20121121>.

<sup>64</sup> This was the first bombing in Tel Aviv since 2006, *see id.*

<sup>65</sup> For an example of Hamas’ use of kidnappings of Israeli civilians, see Baz Ratner, *Hamas Admits to Kidnapping and Killing Israeli Teens*, NPR (Aug. 22, 2014), <http://www.npr.org/2014/08/22/342318367/hamas-finally-admits-to-kidnapping-and-killing-israeli-teens>. For an example of Hamas’ use of kidnappings of Israeli soldiers, see Yoav Zitun *Hamas Used Ceasefire to Kidnap Soldier; Ceasefire Over*, YNET NEWS (Aug. 1, 2014), <http://www.ynetnews.com/articles/0,7340,L-4553302,00.html>.

<sup>66</sup> In one noted incident, Hamas also tried to infiltrate Israeli territory by sea. See Lilach Shoval and Gadi Golan, *IDF foils Hamas naval commando attack*, ISRAEL HAYOM (July 9, 2014), [http://www.israelhayom.com/site/newsletter\\_article.php?id=18687](http://www.israelhayom.com/site/newsletter_article.php?id=18687).

<sup>67</sup> Jeffrey White, in his compilation of battle reports from Operation Protective Edge, documents that the vast majority of fatalities came from Israel’s ground incursion rather than rockets. See Jeffrey White, *The Combat Performance of Hamas in the Gaza War of 2014*, CTC SENTINEL (Sept. 29, 2014), <https://www.ctc.usma.edu/v2/wp-content/uploads/2014/09/CTCSentinel-Vol7Iss93.pdf>.

<sup>68</sup> See *Operation Protective Edge Q&A*, ISRAEL MINISTRY OF FOREIGN AFFAIRS (Aug. 14, 2014), <http://mfa.gov.il/MFA/ForeignPolicy/Issues/Pages/Operation-Protective-Edge-QA.aspx>.

rocket-fire without the use of an extensive ground campaign.<sup>69</sup> In 2008, before the full deployment of Iron Dome, Israel's response to Hamas' rockets included an air and naval bombardment as well as a ground incursion to root out Hamas projectile factories, launch pads and stockpiles. Despite the significant increase in average rocket fire during Operation Pillar of Defense, Israel exclusively used targeted air strikes to achieve its military aims. Even during Operation Protective Edge, this goal was left primarily to air strikes—with the ground incursion taking place only at a later stage in the conflict and focused almost exclusively on dismantling Hamas tunnels.

We cannot but acknowledge the enormous increase in the quantity of rocket fire, the extended range of Hamas rockets, and Hamas' attempts at attacking Israel by sea and from underground tunnels. Such escalation of violence (referred to in the diagram as Conflict Escalation Type A) raises existential questions for IHL. Encouraging and promoting IDSs could mean more violence and violence of a kind that cannot be neutralized by the systems. It would also constitute the most troubling acknowledgement to date of IHL's failure to normalize the behavior of non-compliant parties and the need to rely on external tools instead. While IDSs attempt to correct this fundamental problem, they highlight a paradox whose implications for IHL are far-reaching. Simply put, as power asymmetry between warring parties increases, IHL compliance by the less powerful party is likely to decrease. Regardless of how IHL chooses to conceptualize intelligent defense systems, the legitimacy of IHL as a corpus of law is likely to be weakened as a result.

IHL could disincentivize the use of IDSs to prevent further escalation. But were IHL to disincentivize the Iron Dome, it would undermine the quintessential goal of IHL: the reduction of harm to civilians. Weakening its own foundations and principles, IHL would risk growing irrelevant in the conduct of war.

Disincentivizing IDSs would also endanger civilian life on both sides of the conflict. Any such attempt should thus be thoroughly and cautiously examined within the prism of the Asymmetric Escalation Paradox.<sup>70</sup> While one could point to the high number of civilian casualties that occurred in Operation Protective Edge of 2014 (compared to other conflicts between Israel and Hamas) to argue against the deployment of the Iron Dome, such a position discounts important, more tangible statistics. As noted above, Operation Protective Edge lasted longer than prior conflicts, saw an Israeli ground incursion that resulted in substantial casualties on both sides, and focused primarily on destroying Hamas attack tunnels (not rocket launchers). Although the operation caused an estimated 1,283

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<sup>69</sup> Gabi Siboni, *Operations Cast Lead, Pillar of Defense, and Protective Edge: A Comparative Review*, 27 in *THE LESSONS OF OPERATION PROTECTIVE EDGE* 39 (Anat Kurz and Shlomo Brom eds., 2014).

<sup>70</sup> For example, as explained in Part II, any attempt at banning all autonomous weapons would have to be cautiously considered as it would disincentivize the development and use of intelligent defense systems.

Palestinian civilian casualties in Gaza as compared to Operation Cast Lead's 376, fewer Palestinian casualties occurred per day and per rocket fired in Operation Protective Edge.<sup>71</sup>

These statistics are ultimately a better indicator of the role IDSs play in conflict. We believe that IDSs, despite the possibility of conflict escalation, give expression to IHL's humanitarian purpose. By coming out against IDSs, whether through a ban on autonomous systems or by treating IDSs as military objectives, IHL would hinder their development and implementation, erode the very humanitarian purpose that spawned their creation, and undermine its own core objectives.

## II. Conceptualizing Intelligent Defense Systems under IHL

As the use and performance of IDSs grow, so does the need for IHL to adapt.<sup>72</sup> In spite of the difficulty and far-reaching implications, IHL *must* adapt, just like it did in the past whenever new technologies called for legal adjustments. We argue in favor of incentivizing IDSs and proceed to conceptualize IDSs under international humanitarian law. We demonstrate, first, that IDSs qualify as autonomous systems; second, that they do not qualify as weapons; third, that IDSs do not qualify as military objectives; and fourth, that they ought to be regarded as civil defense.

### A. *Why Incentivize?*

Part I demonstrated the side effects of IDSs, using the Iron Dome as an example. The data, albeit limited, raises far-reaching questions about the effectiveness and desirability of such systems.<sup>73</sup> It suggests, *inter alia*, that using

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<sup>71</sup> The number of Palestinian casualties per rocket fired is an important and nuanced measure of all three rocket-based conflicts between Hamas and Israel (in Operation Cast Lead 1.76; in Operation Pillar of Defense 17.31; and in Operation Protective Edge 3.51). Each conflict differed in length for multiple reasons that are impossible to disaggregate. However, one of the Iron Dome's main contributions is that its interceptions provide diminished pressure on Israel to target rocket launch sites or rocket stashes that might result in Palestinian civilian casualties. By measuring casualties by rockets fired we highlight this diminished pressure and emphasize the positive consequences of employing the Iron Dome.

<sup>72</sup> See *infra* notes 104–06.

<sup>73</sup> When raising concerns about the limited data, it is helpful to note that nuclear weapons have only been actively used twice, both during the same war, yet the amount of scholarship regarding nuclear weapons is immeasurably large and important in political science and international relations specifically. Academic research on nuclear weapons came to the forefront of political science after Thomas Schelling, *ARMS AND INFLUENCE* (1960). Nuclear policy was already the most critical foreign policy strategy of the armed forces during this period of the Cold War. See *THE EFFECTS OF NUCLEAR WEAPONS* (Samuel Glasstone ed., 1964). Consequently, nuclear weapons have remained on the forefront of international relations theory and have been analyzed by nearly all of the field's prominent scholars (see, e.g., Kenneth Waltz, *THE SPREAD OF NUCLEAR WEAPONS: MORE MAY BE BETTER* (1981); Henry A. Kissinger, *NUCLEAR WEAPONS AND FOREIGN POLICY* (1984); Robert Jervis, *THE ILLOGIC OF AMERICAN NUCLEAR STRATEGY* (1984);

an IDS leads to conflict escalation, places civilians at heightened risk (though not necessarily lethal risk), and ultimately perpetuates non-compliance. The question therefore arises of whether IHL ought to promote the use of systems that have arguably been shown to have such effects in the short and long term.

The ideal position, we argue, should be to incentivize IDSs and promote their use in spite of the drawbacks exposed above. Ultimately, both incentivizing and disincentivizing Iron Dome could lead to conflict escalation and a loss of legitimacy for IHL (as shown in the diagram). But the type of escalation differs. As noted above, the use of IDSs likely leads to an increase in rocket fire and the emergence or reemergence of violent tactics. Importantly, however, the characteristics of such escalation are significant non-quantifiable: it is virtually impossible to isolate the impact of an IDS on the intensity of rocket fire, the prolongation of the conflict or the emergence of tactics given the number of factors at play.

By contrast, disincentivizing IDSs leads to a very tangible result—the death of innocent civilians. The analysis of conflict data prior to the Iron Dome’s introduction (this is Conflict Escalation Type B) is quite clear in this respect. We believe that increasing the number of civilians at risk from projectile fire is a lesser evil compared to the quantifiable death of innocent civilians from non-intercepted projectile fire. Importantly, the data shows that the use of an IDS not only reduces casualties for the party that uses it, but also reduces casualties among the civilians of the other side.<sup>74</sup> This, in our view, advocates in favor of incentivizing IDSs under IHL.

Additional reasons confirm and strengthen this choice. Incentivizing IDSs furthers the goals of IHL by protecting civilians from the conduct of hostilities. At a time where most conflicts take place in close proximity to urban areas, it would be absurd for IHL not to promote technology that affords civilians an increased level of protection. IDSs also prevent war crimes from materializing—another remarkable feature of IDSs—and thereby “fix” the inability of IHL to encourage compliance with the law.<sup>75</sup>

Offense-defense theory provides another reason for why IHL should incentivize IDSs.<sup>76</sup> Offense-defense theory contends “international conflict and

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and Scott Sagan, *Why Do States Build Nuclear Weapons? Three Models in Search of a Bomb*, 21 INT’L SECURITY 54 (1996)).

<sup>74</sup> See *supra* notes 60, 61; see also Appendix, Total Israeli Fatalities and Israeli Civilian Rocket Fatalities.

<sup>75</sup> See text *supra* before note 14.

<sup>76</sup> It is important to note that the theory has been criticized by a number of scholars who have argued, *inter alia*, that it is difficult to distinguish between offensive and defensive weapons (see, for example, Lynn-Jones, *Offense-Defense Theory*, *supra* note 11, at 672; GRAY COLIN, WEAPONS DON’T MAKE WAR: POLICY, STRATEGY AND MILITARY TECHNOLOGY (1993), at 31; and Samuel Huntington, *U.S. Defense Strategy: The Strategic Innovations of the Reagan Years*, in AMERICAN

war are more likely when offense has the advantage, while peace and cooperation are more probable when defense has the advantage.”<sup>77</sup> This is because:

[O]ffensive superiority increases the benefits from striking first and increases the costs of allowing the adversary to strike first. This increases in turn the incentives to strike first and therefore the likelihood of war. Defensive superiority reduces both the benefits to the attacker who initiates a war and the costs to the defender who waits and absorbs the first blow, leaves neither side with an incentive to strike first, and thus reduces the likelihood of war.<sup>78</sup>

While technology is typically associated with offense, offense-defense theory promotes the use of technology at the service of the defense:

Two types of technological changes affect the offense-defense balance. First, weapons innovation may produce a new type of weapon that makes it possible to pursue a given type of strategy at lower cost. The development of cannons and other siege machinery, for example, reduced the cost of launching offensives against fortified castles . . . Second, nonmilitary technological innovations may reduce the costs of producing a particular type of weapon.<sup>79</sup>

Under offense-defense theory, an emphasis on defense ought to promote peace, cooperation, and security. Intelligent defense systems embody this insight almost perfectly, as they place technology strictly at the service of the defense. IDSs are defensive in nature in the sense that they are designed to counter forthcoming attacks. Importantly, and unlike other defensive systems, IDSs do not preempt potential attacks: intelligent defense systems defend against *impending* attacks. This feature distinguishes IDSs from drones, which are used to preempt

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DEFENSE ANNUAL, 1987–1988 (Joseph Kruzal, ed.) (1987), 23s, 35s. This, they argue, weakens offense-defense theory at the outset. There are two possible answers to this critique in the context of IDSs. First, IDSs do not constitute weapons. Second, even if they were to be classified as weapons, their defensive nature leaves little doubt, as they do not possess direct offensive capabilities.

<sup>77</sup> Lynn-Jones, *Offense-Defense Theory*, *supra* note 11, at 661.

<sup>78</sup> Jack S. Levy, *The Offensive/Defensive Balance of Military Technology: A Theoretical and Historical Analysis*, 28 INT’L STUD. QUARTERLY 219 (1984).

<sup>79</sup> Sean Lynn-Jones, *Does Offense-Defense Theory Have a Future?* Working Paper, Research Group in International Security, Université de Montréal 18 (2001); *see also* Robert Jervis, *Cooperation under the Security Dilemma*, 30 WORLD POL. 167, 194 (1978) (arguing that “technology and geography are the two main factors that determine whether the offense or the defense has the advantage”). *Cf.* Stephen Biddle, *Rebuilding the Foundations of Offense-Defense Theory*, 63 J. OF POL. 741 (2001) (arguing that “technology does not have the powerful causal effects claimed by orthodox theorists”).

future attacks.<sup>80</sup> It also sets IDSs apart from nuclear weapons—a topic heavily discussed in offense-defense theory—where typically the attack is a mere possibility, and “defense” consists of responding with a kinetic and highly destructive attack.<sup>81</sup> As compared to nuclear weapons, which have been framed as defensive in offense-defense scholarship, there is little doubt that IDSs qualify as defensive.<sup>82</sup>

Empirically speaking, the impact of IDSs on security is still shrouded with some uncertainty. This is the result of their limited operational use in conflict and the lack of any significant study about IDSs in the literature. Like IHL, offense-defense theory has little to offer on IDSs. Both are equally ill-equipped to deal with this relatively new system, designed to save lives and incapable of offensive action. While a few scholars have analyzed offense-defense theory in the context of internal conflicts,<sup>83</sup> the relevance of offense-defense theory in the context of terrorism has hardly been discussed.<sup>84</sup>

While offense-defense theory does suggest that incentivizing IDSs would yield beneficial results for international security, it is important to keep in mind that the theory underscores the need for equilibrium between offense and defense: it posits that states should not exclusively build up their offensive capabilities but should achieve a balance between offense and defense.<sup>85</sup> Such balance affords states enough military capability to defend their interests while only minimally threatening other states. What is surprising, however, is that international relations (IR) scholarship barely addresses the modalities of this balancing act: What is the ideal ratio between offense and defense in terms of budget and capability? In a significant attempt at addressing the nature of this balance in greater depth, Sean

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<sup>80</sup> See Itai Saltzman, *Cyber Posturing and the Offense-Defense Balance*, 34 CONTEMPORARY SECURITY POLICY 40 (2013). For a hypothetical case study using the Korean peninsula, see Andrew Mack, *The Theory of Non-provocative Defense: How Relevant for Korea?*, 3 KOREAN J. OF DEF. ANALYSIS 241 (1991).

<sup>81</sup> See ROBERT JERVIS, *THE MEANING OF THE NUCLEAR REVOLUTION* 29–34 (1989); ROBERT JERVIS, *THE ILLOGIC OF AMERICAN NUCLEAR STRATEGY* 153–57 (1984).

<sup>82</sup> Defense refers to a broad array of measures and tools designed “to repel attack, to protect people and property, to hold territory, and to minimize damage by the attacker.” See David Tarr, *Defense as Strategy: A Conceptual Analysis*, in NATIONAL SECURITY STRATEGY: CHOICES AND LIMITS 217 (Stephen J. Cimbala ed., 1984); ROBERT JERVIS, *THE USE OF FORCE: MILITARY POWER AND INTERNATIONAL POLITICS*, 58 (2015) (“the essence of defense is keeping the other side out of your territory. A purely defensive weapon is one that can do this without being able to penetrate the enemy's land.”).

<sup>83</sup> See, e.g., Barry Posen, *The Security Dilemma and Ethnic Conflict*, 20 INT’L SEC. 136 (1996); William Rose, *The Security Dilemma: Some New Hypotheses*, 9 SEC. STUDIES 1 (2000); and Jack Snyder and Robert Jervis, *Civil War and the Security Dilemma* in CIVIL WARS, INSECURITY, AND INTERVENTION 15 (Barbara Walter and Jack Snyder, eds., 1999). Even guerilla war has not been clearly rationalized under the offense-defense theory (see George H. Quester, *OFFENSE AND DEFENSE IN THE INTERNATIONAL SYSTEM* 177, 181, 184 (2003)).

<sup>84</sup> But see Richard Betts, *The Soft Underbelly of American Primacy: Tactical Advantages of Terror*, 117 POL. SCIENCE Q. 19 (2002).

<sup>85</sup> Lynn-Jones, *Offense-Defense Theory*, *supra* note 11, at, 674–75.



Lynn-Jones notes that “the offense-defense balance is a continuous variable, not a dichotomous one” and that “terms like ‘offense-dominance’ and ‘defense-dominance’ are misleading.”<sup>86</sup> It appears that finding the right balance along the offense-defense “continuum” is more important than “defense dominance” per se.<sup>87</sup> By employing IDSs, a defensive tool, states may achieve the optimal place on this continuum, resulting in greater security and limited intensity of war.

Weighing these benefits against the risk of losing IHL legitimacy as a body of law and possibly causing escalation, should IHL incentivize IDSs? A pro-IDS stance on the part of IHL would promote a perception of IDSs as life-saving systems (rather than as a military-developed and military-operated apparatus), contribute to tilting the balance in favor of defense, and thus contain escalation as predicted by offense-defense theory.

For reasons grounded in IHL itself, data analysis on Iron Dome, and insights gained from offense-defense theory, we therefore suggest that IHL should incentivize intelligent defense systems. In the following sections, we discuss how IHL can do so.

### B. *Autonomous Systems*

As noted above, this paper argues in favor of IHL taking a clearer stance vis-à-vis IDSs. One way to do so would be to explicitly exclude IDSs from the emerging regulation governing autonomous weapons.

Drones, robots, and other autonomous technologies have sought to alleviate this risk of urban warfare and guerilla tactics by enabling war to be waged remotely and more precisely. Unsurprisingly, these technologies have captured the attention of international legal scholars as well as governments, non-governmental organizations, and international organizations.<sup>88</sup> The debate has focused on the challenges “autonomous weapons” pose to the implementation of international humanitarian law.<sup>89</sup> Though numerous actors and scholars have attempted to delineate and organize “autonomous weapons” into legal categories, a critical gap in this literature is left underexplored—the autonomous capabilities of intelligent defense systems.

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<sup>86</sup> Lynn-Jones, *supra* note 11, at 689.

<sup>87</sup> *Id.* at 666.

<sup>88</sup> See generally *Targeted Killing and Drones*, Human Rights Watch, <https://www.hrw.org/topic/terrorism-counterterrorism/targeted-killings-and-drones>. Drones and other autonomous technology have also received substantial criticism from the UN. See Ben Emmerson, Special Rapporteur on the Promotion and Protection of Human Rights and Fundamental Freedoms While Countering Terrorism, Report of the Special Rapporteur on the Promotion and Protection of Human Rights and Fundamental Freedoms While Countering Terrorism, U.N. Doc A/HRC/25/59 (Feb. 28, 2014). For a different view, see Kenneth Anderson, Daniel Reisner and Matthew Waxman, *Adapting the Law of Armed Conflict to Autonomous Weapons Systems*, 90 INT’L L. STUD. 386 (2014).

<sup>89</sup> See generally Emmerson, *id.*

There is little doubt that IDSs qualify as autonomous, hence the potential for confusion with autonomous weapons. IDSs typically consist of a radar (to detect incoming projectile threats), a computer-processing center (to track said threats), a launcher (which houses the missile interceptors), and a missile interceptor (to destroy projectile threats). Examples of IDSs include the U.S.-produced and widely-used Patriot Missile System—with multiple variations including the Patriot Advanced Capability-3 deployed in Israel (PAC-3),<sup>90</sup> the Iron Dome, and “David’s Sling.”<sup>91</sup> Alternative names used by manufacturers of IDSs include “air and missile defense system,”<sup>92</sup> “integrated defense system,”<sup>93</sup> “advanced defense system,”<sup>94</sup> and “active defense system.”<sup>95</sup> These names, though occasionally used interchangeably, do not necessarily represent a cohesive categorization of systems. IDSs differ from defense systems with narrower scopes such as the Phalanx CIWS or the Aegis designed to protect specific military objectives like a ship,<sup>96</sup> and from national missile defense systems like the Terminal High Altitude Area Defense THAAD system designed to protect entire countries or continents from exo-atmospheric projectiles, often intercontinental ballistic missiles.<sup>97</sup> IDSs, in contrast, are deployed to intercept statistical distribution rockets and mortars launched at civilian targets or in a manner that would, at minimum, label them indiscriminate.<sup>98</sup>

IDSs are autonomous as they can identify, track, and engage targets without human interference. Importantly for our purposes, IDSs are also intelligent (they can discriminate between projectiles that pose significant threats and projectiles that will ultimately fall in unpopulated areas) and “strictly defensive” (the system is utilized in a way that causes no immediate offensive advantage to its user and does not directly harm enemy combatants or enemy civilians).

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<sup>90</sup> *Patriot*, Raytheon Company, <http://www.raytheon.com/capabilities/products/patriot/>.

<sup>91</sup> Ruth Eglash and William Booth, *Israel to Launch One of the Most Advanced Missile Defense Systems in the World, with US Help*, WASH. POST (Mar. 3, 2016).

<sup>92</sup> *Air and Missile Defense*, Raytheon Company, <http://www.raytheon.com/capabilities/missiledefense/index.html>.

<sup>93</sup> *Id.*

<sup>94</sup> *Defense against Short Range Artillery Rockets*, Rafael Advanced Defense Systems Ltd., [www.rafael.co.il/Marketing/186-1530-en/Marketing.aspx](http://www.rafael.co.il/Marketing/186-1530-en/Marketing.aspx).

<sup>95</sup> *Rafael Financial Results for 2015*, Rafael Advanced Defense Systems Ltd., [http://www.rafael.co.il/marketing/SIP\\_STORAGE/FILES/3/1323.pdf](http://www.rafael.co.il/marketing/SIP_STORAGE/FILES/3/1323.pdf).

<sup>96</sup> *Phalanx Close-In Weapon System (CIWS)*, Raytheon Company, <http://www.raytheon.com/capabilities/products/phalanx/>.

<sup>97</sup> *Countering the Growing Ballistic Missile Threat*, Raytheon Company, <http://www.raytheon.com/capabilities/products/antpy2/>.

<sup>98</sup> Under our definition, IDSs are used primarily in the defense of civilians. *See supra* note 2. We acknowledge that IDSs could conceivably be utilized in alternative capacities—which would, in turn, affect the analysis. It is important to note in this context that David’s Sling—the Iron Dome’s successor—will be able to intercept certain guided missile-types including cruise-missiles. It has even been suggested that a recent upgrade to the Iron Dome will allow it to intercept drones (*see Rafael Advanced Defense Systems Releases Clip of the Iron Dome Shooting Down an Unmanned Aerial Vehicle*, JERUSALEM POST (July 13, 2015)).

The regulation of autonomous weapons, if applicable to IDSs, would have potentially far-reaching consequences on the development and deployment of these systems. The operational impact of IDSs is rapidly expanding. IDSs already represent a multibillion-dollar product line:<sup>99</sup> Some 17 countries currently possess systems that could be classified as IDSs under certain circumstances, while many more are considering their acquisition.<sup>100</sup> Though infrequently tested in battle since their implementation, this is likely to change as certain derivations of the Patriot System are now located in nations under significant threat of rocket and missile fire—including South Korea, Japan, the U.A.E., and Saudi Arabia.<sup>101</sup> The rapid proliferation of mortars, rockets, and missiles into conflict areas, coupled with their diminishing development and production costs, only strengthens the growth potential of, and market for, IDSs. Perhaps the best embodiment of IDSs' remarkable capabilities is Israel's Iron Dome—the most successful battle-tested IDS in history<sup>102</sup>—which is currently employed as a multi-battery interoperated arrangement intended to protect Israel's population from direct and indiscriminate rocket and mortar attacks. Israel is cooperating with India to develop IDSs,<sup>103</sup> and has offered to sell the technology to Saudi Arabia to counter the threat from Huthi rebels in Yemen.<sup>104</sup>

The ongoing debate surrounding the legality of autonomous weapon systems carries a sense of déjà-vu. IHL has typically been slow to adapt to technological advances. At the First Hague conference in 1899, states imposed a five-year moratorium on projectile and explosion discharge via hot air balloons<sup>105</sup> out of ethical concerns: a weapons system where the attacker was out of harm's way, they claimed, is unfair.<sup>106</sup> The real concern of states opposed to hot air balloons was in reality much deeper. They feared that they would not be able to develop or acquire the said technology.<sup>107</sup> By 1907, the rapid proliferation of balloon technology and its unseating in value from the development of fixed-wing aircraft resulted in a renewal of the previous 1899 moratorium, albeit with more

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<sup>99</sup> See *Patriot*, *supra* note 90.

<sup>100</sup> *Id.*

<sup>101</sup> See Shalal-Esa, *supra* note 1.

<sup>102</sup> According to Gordon R. Mitchell, *Placebo Defense: Operation Desert Mirage? The Rhetoric of Patriot Missile Accuracy in the 1991 Persian Gulf War*, 86 Q. J. OF SPEECH 121, 134 (2000), the Patriot Missile System had between a 20–40% success rate depending on how “success” is defined. Our data—see p. 21 and Appendix p. 74—show the Iron Dome's success rate has ranged between 84–91% depending on time of deployment.

<sup>103</sup> Yuval Azulai, *Rafael Sets up Joint Venture with India's Kalyani*, GLOBES (Feb. 19, 2015), <http://www.globes.co.il/en/article-rafael-sets-up-joint-venture-with-indias-kalyani-group-1001011924>.

<sup>104</sup> *Rocket Defense System Was Offered for Saudis to Secure its Border with Yemen*, JERUSALEM POST (May 23, 2015), <http://www.jpost.com/Middle-East/Report-Israel-offered-Saudi-Arabia-use-of-its-Iron-Dome-technology-403893>.

<sup>105</sup> Dietrich Schindler & Jiří Toman, *THE LAWS OF ARMED CONFLICTS* 202–04 (1988).

<sup>106</sup> Daniel Reisner, Presentation at the Minerva Center for Human Rights at the Hebrew University on Military Objects and Objectives of War: An Uneasy Relationship (Nov. 2013).

<sup>107</sup> *Id.*

ambiguous wording and much less support.<sup>108</sup> This specific ban never evolved into customary international law as the bulk of states no longer found it valuable or relevant. Later codifications sought to restrict the use of chemical and biological weapons, cluster munitions, and anti-personnel landmines.<sup>109</sup> It is fair to say that international law has been “losing a running battle with technological developments that have vastly increased the killing power of military forces.”<sup>110</sup>

The development of autonomous weapons has raised similar regulatory concerns.<sup>111</sup> Human Rights Watch initiated the debate in November 2012 with a report entitled *Losing Humanity: The Case against Killer Robots*, a report that takes a strong stance against the development and use of autonomous technology in warfare.<sup>112</sup> It asserts that fully autonomous weapons “would not be able to abide by”<sup>113</sup> the critical “rules of distinction, proportionality and military necessity” because IHL inherently “requires human judgment.”<sup>114</sup> The response to the report has been very critical. Michael Schmitt noted that it “is based on unfounded assumptions as to the nature of [autonomous] systems” and fails to account for their likely use in the future.<sup>115</sup> Schmitt criticized Human Rights Watch’s overly simplistic classification and provided a far more detailed analysis of autonomous systems. Most importantly for our purposes, Schmitt acknowledged that the Iron Dome, Aegis and the Patriot qualify as a “human-supervised autonomous weapon systems.”<sup>116</sup> Anderson, Reisner and Waxman not only noted the highly automated nature of the US Patriot, the Phalanx system, and the Iron Dome, but also their unique function as compared to other autonomous systems.<sup>117</sup>

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<sup>108</sup> 1 *The Law of Air Warfare: Contemporary Issues* 5 (Natalino Ronzitti and Gabriella Venturini, eds. 2006). We are indebted to Col. (Ret.) Daniel Reisner for this point.

<sup>109</sup> See 1972 Biological Weapons Convention, 1015 U.N.T.S. 163; 1993 Chemical Weapons Convention, 1974 U.N.T.S. 45; 2008 Convention on Cluster Munitions, 2688 U.N.T.S. 47713; 1997 Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction, 2046 U.N.T.S. 241. Daniel Reisner discussed this issue in *The Use and Abuse of Drones*, his talk at a conference sponsored by the Institute for National Security and Counterterrorism at Syracuse Law School and the Institute for Counterterrorism: Law & Security: Perspectives from the Field and Beyond (July 2013). Additional examples include the longbow, which many European nations objected to, and poisonous weapons.

<sup>110</sup> David P. Fidler, *International Legal Implications of Non-Lethal Weapons*, 21 MICH. J. INT’L L. 51, 52 (1999).

<sup>111</sup> See, e.g., AMNESTY INTERNATIONAL, AS IF HELL FELL ON ME: THE HUMAN RIGHTS CRISIS IN NORTHWEST PAKISTAN (2010).

<sup>112</sup> HUMAN RIGHTS WATCH, LOSING HUMANITY: THE CASE AGAINST KILLER ROBOTS (2012).

<sup>113</sup> *Id.* at 3.

<sup>114</sup> *Id.* at 4.

<sup>115</sup> Michael Schmitt, *Autonomous Weapons Systems and International Humanitarian Law: A Reply to the Critics*, 4 HARV. NAT’L SEC. J. 1, 3 (2013).

<sup>116</sup> *Id.* at 5. Schmitt categorizes systems like the Iron Dome as “human in the loop.” While autonomous, these systems can be overridden by those who oversee their deployment. Schmitt also includes in this category systems such as Aegis.

<sup>117</sup> See *supra* note 88, at 390, 406.

Indeed, blanket statements on the legality of autonomous systems of the type made by Human Rights Watch have positioned the debate around projected and counterfactual implementations of this technology during combat. In contrast with most autonomous military technologies such as autonomous aerial drones<sup>118</sup> and other UAVs, IDSs generally do not directly or significantly increase their users' offensive capability. Rather, they seek to neutralize an enemy's offensive, and often unlawful, projectile capability.<sup>119</sup> IDSs thus underscore a much less contentious application of (non-lethal) autonomous technology. They provide a rather convincing counter-example to the sweeping criticism voiced against semi- or wholly autonomous weapons.

It is too early to predict the outcome of the controversy over the legality of autonomous weapons.<sup>120</sup> But regardless of how it evolves, any regulatory steps should be mindful not to impede the development of intelligent defense systems and their humanitarian purpose.

### C. *System or Weapon?*

When seeking to conceptualize IDSs, the question arises of whether intelligent defense systems qualify as “weapons” under the law. IHL places specific restrictions on the development and use of weapons, including by subjecting new weapons to a legal review in order to determine whether they can lawfully be used in war.<sup>121</sup> Weapons review, if deemed applicable to intelligent defense systems, would hinder states' ability to develop the life-saving technology. This would appear inconsistent with IHL's deep concern for civilian life. As we discuss further in Part II, IHL should promote—or at least avoid placing any restrictions—on the use of a system designed to protect rather than

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<sup>118</sup> Sefer Kurnaz, Omer Cetin & Okyay Kaynak, *Fuzzy Logic Based Approach to Design of Flight Control and Navigation Tasks for Autonomous Unmanned Aerial Vehicles*, 54 J. OF INTELLIGENT AND ROBOTIC SYSTEMS 229 (2009).

<sup>119</sup> See AP I, *supra* note 21, art. 51(4)(b) (“those which employ a method or means of combat which cannot be directed at a specific military objective”).

<sup>120</sup> See *Meeting of the High Contracting Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects, Report of the 2014 Informal Meeting of Experts on Lethal Autonomous Weapons Systems (LAWS)*, U.N. Doc. CCW/MSP/2014/3 (June 11, 2014) (highlighting the importance of defining autonomous weapons systems and the need to “preserve research and development on peaceful applications of robotics given their foreseeable positive impact, for instance on health care, agriculture or rescue operations”—though there was no mention of the potential positive contribution of autonomous weapons on the battlefield.).

<sup>121</sup> See AP I, *supra* note 21, art. 36. Article 36 of Additional Protocol I requires State parties to conduct a thorough review of the weapon, including its legality under existing international law, and an empirical review of the type and extent of damage to health, civilian life, and the environment likely to be caused as a result of its use. Future developments in the law should also be taken into account (see *A Guide to the Legal Review of New Weapons, Means and Methods of Warfare: Measures to Implement Article 36 of Additional Protocol I of 1977*, INT’L COMM. OF THE RED CROSS (Jan. 2006), [https://www.icrc.org/eng/assets/files/other/icrc\\_002\\_0902.pdf](https://www.icrc.org/eng/assets/files/other/icrc_002_0902.pdf) [hereinafter “New Weapons Review Guide”])

attack. From the point of view of states relying on IDSs for the inimitable protections they provide to their civilians and soldiers, restrictions on the development of IDSs seem equally undesirable.

IHL has also prohibited the development and use of certain weapons through specific treaties. As early as 1868, the Saint Petersburg Declaration prohibited the use of explosive projectiles weighing less than 400 grams. Following the tragedies of World War I, governments banned the use of poison gas and bacteriological means of warfare through the Geneva Protocol in 1925. Protocols to the Convention on Certain Conventional Weapons regulate the use of booby-traps, mines, and laser-blinding weapons.<sup>122</sup> In total, 14 international prohibitions, conventions and declarations have restricted specific weapons and technologies.<sup>123</sup>

Because identifying and prohibiting certain weapons is an important function of IHL,<sup>124</sup> far-reaching consequences flow from the classification of something as a weapon in the first place. Despite these potentially far-reaching consequences, the law does not explicitly define what constitutes a weapon.<sup>125</sup> Article 35 of Additional Protocol I, which dates back from the 1907 Hague Regulations,<sup>126</sup> suggests that certain means of warfare, i.e., weapons, are prohibited: “the right of the Parties to the conflict to choose methods or means of warfare is not unlimited.”<sup>127</sup> Article 36 further provides:

In the study, development, acquisition or adoption of a new *weapon*, means or method of warfare, a High Contracting Party is under an obligation to determine whether its employment would, in some or all circumstances, be prohibited by this Protocol or by any other rule of international law applicable to the High Contracting Party.<sup>128</sup>

It is clear that the law prohibits the use of certain weapons—even though the word *weapon* itself is not defined.<sup>129</sup> According to the ICRC’s Commentary on the Additional Protocols:

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<sup>122</sup> See *Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects* as amended on 21 December 2001 (CCW) and its Protocols.

<sup>123</sup> See INT’L COMM. OF THE RED CROSS, *Weapons*, <http://www.icrc.org/eng/war-and-law/weapons/overview-weapons.html>.

<sup>124</sup> *Id.* See also ICRC Commentary, *supra* note 23, para. 1410 (“At the start of the Conference (a Red Cross) delegate remarked that ‘what was more important than seeking to improve the condition of the wounded was to restrict the use of weapons which caused unnecessary suffering or had indiscriminate effects.’”).

<sup>125</sup> See AP I, *supra* note 21, art. 35.

<sup>126</sup> Convention (IV), *supra* note 23, art. 22.

<sup>127</sup> See AP I, *supra* note 21, art. 35.

<sup>128</sup> See AP I, *supra* note 21, art. 36 (emphasis added).

<sup>129</sup> See *supra* note 123. Importantly, IHL makes no distinction between offensive and defensive weapons, in the sense that a defensive weapon would not necessarily be more likely to pass the

The use that is made of a weapon can be unlawful in itself, or it can be unlawful only under certain conditions. For example, poison is unlawful in itself, as would be any weapon which would, by its very nature, be so imprecise that it would inevitably cause indiscriminate damage. . . . However, a weapon that can be used with precision can also be abusively used against the civilian population. In this case, it is not the weapon which is prohibited, but the method or the way in which it is used.<sup>130</sup>

The absence of a definition leaves the implementation of the law governing weapons dependent on context and interpretation.<sup>131</sup> Unless treaty or customary law explicitly prohibits a weapon, the context and use of that weapon, often reviewed *ex post facto*, will determine the legality of that weapon.<sup>132</sup> As the ICRC notes, “most weapons are not unlawful... whether their use in conflict is lawful or not depends on the circumstances and the way in which they are used.”<sup>133</sup> When establishing how IHL should treat IDS we must first determine whether it qualifies as a weapon, and if it does, we must then address whether or not it is a lawful weapon.

According to the Merriam Webster Dictionary, a weapon is: “something (such as a gun, knife, club, or bomb) that is used for fighting or attacking someone or for defending yourself when someone is attacking you.”<sup>134</sup> This definition, albeit not a legal one, places an emphasis on things “used for fighting” and makes no distinction between offensive and defensive uses. The Webster definition suggests that objects destined to play a role in fighting are considered weapons—for example, a gun. One could certainly point out that not all guns are used for fighting (e.g. a flare gun) or that objects not designed for fighting can be used as weapons (e.g. a brick). Nearly anything, even something as mundane as a toothpick or a coconut, could conceivably be used in a manner that would classify it as a weapon. The examples listed in the Webster definition can all inflict some sort of offensive damage—specifically harm to humans. It does not tell us whether an object used exclusively “for defending yourself” may constitute a

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review than an offensive weapon. In other words, a defensive weapon would be regarded as a weapon for purposes of IHL and thus subject to review and other applicable provisions. This points to an important gap between international law and international relations as far as the definition of weapon is concerned.

<sup>130</sup> See ICRC Commentary, *supra* note 23, para. 1402.

<sup>131</sup> See New Weapons Review Guide, *supra* note 21 (noting that many of the rules related to weapons review are context dependent).

<sup>132</sup> Fidler, *supra* note 110, at 63, 64; see also Schmitt, *supra* note 115, at 30.

<sup>133</sup> *Round Table on New Weapon Technologies and IHL: Conclusions*, INT’L COMM. OF THE RED CROSS RESOURCE CENTER (Sept. 2011), <https://www.icrc.org/eng/resources/documents/statement/new-weapon-technologies-statement-2011-09-13.htm>.

<sup>134</sup> *Weapon*, MERRIAM WEBSTER DICTIONARY, <http://www.merriam-webster.com/dictionary/weapon>.

weapon. As such, the definition of weapons provided by the Webster dictionary does not account for IDSs.

Consider Iron Dome as an example. The system does not currently possess any direct offensive capability. While it relies on kinetic force, such force may only be exercised defensively against launched explosive projectiles. Even when an interceptor misses its target, the interceptors automatically return to a pre-programmed location, making it impossible for the interceptors to act offensively.<sup>135</sup> IDSs thus raise the important and broader question of how systems releasing kinetic force, used in military operations, but *not* possessing the capability to destroy or harm, should be conceptualized under the law.

IHL does not regard defensive objects commonly used in battle, like body armors or bunkers, as weapons.<sup>136</sup> A person wearing body armor may be able to endure a direct hit from a bullet, allowing them to continue fighting. Like body armor, a bunker can protect troops and ammunition from being destroyed by bombs, missiles, and artillery. These examples suggest that purely defensive objects, even if designed for use in battle, do not necessarily qualify as weapons under IHL.<sup>137</sup>

Unlike body armors or bunkers, however, IDSs do release kinetic force. For the sake of comparison, landmines, like IDSs, release kinetic force that is triggered by an offensive action from the enemy. Not only have landmines been designated as a “weapon” by IHL, but their use is also explicitly banned by the so-called Mine Ban Treaty.<sup>138</sup> Similarly, air defense systems, which can target approaching aircrafts, release kinetic force when triggered by a foe. Their use in conflict has resulted in the extensive loss of life, and, like landmines, they are conceptualized as weapons under IHL.

While IDSs may seem to operate more like landmines than bunkers, in reality they more closely resemble the latter. Though IDSs destroy incoming projectiles when triggered, the destruction of these objects does not result in any enemy casualties. This separates them from landmines and anti-aircraft systems. One could argue that many non-lethal devices (such as rubber bullets or tasers) are considered weapons—suggesting that the ability to cause death plays no

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<sup>135</sup> Author interview with Iron Dome personnel, June 2014.

<sup>136</sup> This section does not address the question of whether IDSs constitute military objectives but, rather discusses whether they ought to be regarded as a weapon—with the restrictions that such a qualification entails. Other examples of defensive objects used in battle, such as fortifications or protective garments, have never raised any concern and thus clearly do not constitute weapons under the law.

<sup>137</sup> International relations scholar would likely object to this analysis based on the well-accepted distinction between active and passive civil defense (with the Iron Dome qualifying as the former). The distinction, however, is not echoed in the law and there is therefore no reason to believe that the law sought to limit the provisions on civil defense to *passive* civil defense.

<sup>138</sup> See Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction (1999).



definitive role in the classification as weapon. The difference between non-lethal weapons and IDSs, however, is that non-lethal weapons directly target humans resulting in some kind of injury. IDSs do not, by design, target humans. Nor do they directly cause any injury or loss of life to an enemy.

IDSs thus seem to occupy a unique place. They display unique characteristics, effectively setting them apart from weapons such as landmines, guns, knives, and rubber bullets. IDSs are defensive by design, intelligent in their use, and non-lethal. Yet, intuitively, it seems absurd that a system that launches a missile to destroy an incoming projectile could be regarded as anything but a weapon. IHL unequivocally regards missiles as weapons.<sup>139</sup> We contend that the use of missiles to target other unlawful projectiles does not turn the IDS into a weapon. Conceptually, the harder thing to justify with IDSs is that unlike a shelter or body armor that renders an enemy's weapon useless on contact, an IDS engages the weapon proactively *before* contact.

Treating IDSs as weapons would have the undesirable effect of turning a defensive object into a weapon. Consider this scenario: Two men, Joey and Fred are playing baseball. After getting into a heated argument over a call, Joey throws the baseball at Fred's head, an action which is potential lethal. Fred raises his bat over his head, eventually blocking it from hitting him and rendering the ball harmless. That Fred proactively protected himself does not turn the bat into a weapon because it was not used in a way that could harm Joey. This argument carries even greater weight in the case of the Iron Dome, which *cannot* be used to cause lethal harm in its current operating capacity.

Considering the above scenario, when used as a component of IDSs, a missile serves exclusively as the interceptor of indiscriminate rocket-fire. It too should not be considered a weapon because it is not used in a way that directly harms the enemy. Though this analysis challenges our intuition, we must recognize that technology previously used and characterized exclusively as weapon by design can today be used in entirely different ways.<sup>140</sup>

We have established why IDSs do not qualify as weapons. Let us now consider whether—assuming they were regarded as weapons (a view we do not subscribe to, as explained above)—IDS would need to undergo weapons review

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<sup>139</sup> See, e.g., *HPCR Manual on International Law Applicable to Air and Missile Warfare* (HARV. 2010), Section E, Rule 22(a), at 12–13 [herein after “AMW Manual”].

<sup>140</sup> The “knock on the roof” procedure embodies another example of how technology may challenge commonly held assumptions on the modern battlefield: it consists in dropping smart bombs (emptied of all explosives) on targets in order to create a warning to the civilian population. This practice was criticized in the Report of the Independent Commission of Inquiry on the 2014 Gaza Conflict (A/HRC/29/52 (24 June 2015), para. 42) and reportedly used by the United States in Iraq (see Adam Taylor, ‘Israel’s Controversial ‘Roof Knocking’ Tactic Appears in Iraq. And This Time, It’s the U.S. Doing It’, WASH. POST (April 27, 2016), <https://www.washingtonpost.com/news/worldviews/wp/2016/04/27/israels-controversial-roof-knocking-tactic-appears-in-iraq-and-this-time-its-the-u-s-doing-it/>).

as required by Article 36 of Additional Protocol I.<sup>141</sup> State practice unfortunately offers only limited guidance on weapons review. Few States have put in place mechanisms to conduct legal reviews of weapons—and even then information about how weapons review is conducted (procedurally or substantively) is typically not available.<sup>142</sup> Nevertheless, our analysis reveals that IDSs do not warrant a review as they incorporate mechanisms already recognized as lawful. According to the ICRC, weapons review must examine “not only the weapon’s design and characteristics but also how it is to be used, bearing in mind that the weapons’ effects will result from a combination of its design *and* the manner in which it is to be used.”<sup>143</sup> Subject to scrutiny are factors such as the level and type of injury inflicted or capable of being inflicted by the weapon, the potentially indiscriminate nature of the system, and whether the system’s effects are controllable.<sup>144</sup> IDSs do not raise any such issues. Ultimately, weapons review—though in our view not required by law—would not pose any obstacle to the development and use of IDSs.<sup>145</sup>

Beyond these legal considerations, conceptualizing IDSs as weapons holds far-reaching implications for IHL and international security. It would likely (though not inevitably) lead to the classification of the system as a legitimate target. By contrast, absent a qualification as a weapon, IHL would be free to take a positive stance vis-à-vis intelligent defense systems, thereby upholding their humanitarian aspirations. IHL would endow IDSs with the protection and legitimacy they deserve as systems developed to counter indiscriminate attacks.

In search for a middle ground, one could be tempted to separate the various components of an IDS and regard the interceptor—and only the interceptor—as a weapon. A missile interceptor, unlike a computer or radar, is employed with explosives for the purpose of destroying a target. With modern military technologies now relying on a multitude of components, can these components be classified separately? This question arose in relation to drones—

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<sup>141</sup> The question arises of whether Article 36 constitutes customary law. Considering that very few states, even among those that are signatories to Additional Protocol I, have set up formal review mechanisms for new weapons, it is unlikely to be the case. Moreover, it is worth noting that the Martens Clause does not apply to the development and use of IDSs (relevant treaty and customary law governing weapons development already concur to say that all of its components, as well as the combined system, are legal under IHL). Even if it did, there is no indication that it would pose a challenge to the legality of IDSs under IHL. IDSs, by design, uniquely embody the humanitarian principles that the Martens clause seeks to preserve.

<sup>142</sup> See New Weapons Review Guide, *supra* note 121, at 5.

<sup>143</sup> ICRC Commentary, *supra* note 23, at 17 (parenthesis omitted, emphasis in text). That said, the ICRC further notes, “[a] state is not required to foresee or analyze all possible misuses of weapon, for almost any weapon can be misused in a way that would be prohibited.”

<sup>144</sup> ICRC Commentary, *supra* note 23, at 17; AP I, *supra* note 21, arts. 35(3) and 51(4).

<sup>145</sup> Art. 36 of AP I, *supra* note 21, provides as follows: “In the study, development acquisition or adoption of a new weapon, means or method of warfare, a High Contracting Party is under an obligation to determine whether its employment would, in some or all circumstances, be prohibited by this Protocol or by any other rule of international law applicable to the High Contracting Party.”

the drone itself is a relatively new innovation but its hellfire missile, i.e., the weapon it is equipped with, is not.<sup>146</sup> Some argued that the qualification as a weapon, if warranted, could apply to part of the military apparatus only.<sup>147</sup> This notion was ultimately rejected because the drone itself was not considered a weapon, and the weapons that could be attached to a drone, such as a precision missile, had already been in use and thus did not warrant a review. The same would apply to an IDS' components (including its interceptors).

Ultimately, no available evidence suggests that states operating multifaceted weapons systems such as drones or IDSs would regard the combination of new technology with well-accepted and uncontested lawful weapons as calling for weapons review. Neither the law nor state practice suggests that breaking down a system into components might offer a solution.<sup>148</sup>

#### D. *Civilian v. Military Objective*

We now turn to the third, and arguably most controversial step in the conceptualization of IDSs under international humanitarian law: do IDSs constitute military objectives?

One of IHL's main tasks is to identify objects that may be targeted in war—a task with far-reaching consequences for both combatants and civilians. Article 52(2) of Additional Protocol I defines military objectives as “objects which by their nature, location, purpose or use make an effective contribution to military action and whose total or partial destruction, capture or neutralization, in the circumstances ruling at the time, offers a definite military advantage.” In contrast, IHL defines civilian objectives negatively: “civilian objectives are all objects which are not military objectives.”<sup>149</sup> Under this definition, IHL effectively turns protection into the default status. It also places the onus on the attacker to show that the intended target indeed constitutes a military objective. The fundamental nature of the civilian/military distinction is strengthened by Article 85(3) of Additional Protocol I, which turns the act of willfully making civilian population or individual civilians the object of attack into a grave breach of IHL.<sup>150</sup>

<sup>146</sup> See Schmitt, *supra* note 115, at 3.

<sup>147</sup> Tim McCormack & Meredith C. Hagger, *Regulating the Use of Unmanned Combat Vehicles: Are General Principles of International Humanitarian Law Sufficient?*, 21 J. OF LAW, INFO. & SCIENCE 12 (2011).

<sup>148</sup> It is important to note that it would not work in practice anyway. IDSs often use complicated weather sensors to collect data critical in determining the launch angle of a missile interceptor. Without this information, the missile has a much greater chance of missing its target. Despite this direct causal relationship, are we ready to say that an anemometer is a weapon? What about the vital data it acquires?

<sup>149</sup> See AP I, *supra* note 21, art. 52(1).

<sup>150</sup> See ICRC Commentary, *supra* note 23, para. 1932.

At the level of theory, treating IDSs as military objectives would seriously undermine these systems' humanitarian purpose. IHL cannot simultaneously fail to prevent war crimes and dissuade the pursuit of casualty-free technology designed to neutralize them. From the perspective of a state looking to develop or use an intelligent defense system, the military objective label does not seem attractive. Considering the enormous costs of both creating and operating IDSs, a state may be dissuaded to acquire IDSs if these systems are too vulnerable to attack.<sup>151</sup> A qualification as military objective would place the expensive apparatus directly in the line of fire, as well as those civilians located in the vicinity of the IDS, likely the very civilians the system hopes to protect. Death or injury inflicted upon civilians located in the vicinity would probably be regarded as acceptable collateral damage to the attack launched on the IDS. In other words, the key inquiry is not simply whether an IDS constitutes a military objective, but also whether a strike against an IDS can justify civilian casualties. Treating an IDS as a military objective would increase both the costs of defense and the vulnerability of civilians.

Iron Dome, for example, provides a protective cap over surrounding cities and villages threatened by mortars and rocket-fire. Treating the system as a military objective would mean that civilian casualties resulting from its incapacitation or destruction would be considered lawful (assuming these casualties are not excessive in comparison to the military advantage anticipated from the strike).

In addition, the system's proximity to civilian areas could violate a state's obligation to take all necessary precautions to protect its civilians and perhaps also the prohibition not to use the civilian population to render military objectives immune from military operations. Paradoxically, IHL would then require the system to be moved out of the range of Hamas rockets, where its dome of protection (designed to benefit the civilian population) would be significantly less valuable. If the system is considered a civilian object, however, deaths resulting from its incapacitation or destruction would constitute violations of IHL.<sup>152</sup>

The relevant legal provisions must be analyzed with these concerns in mind.<sup>153</sup> Strangely enough, the precise meaning of "nature, location, purpose or

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<sup>151</sup> For example, a single Iron Dome battery is estimated to cost between \$50,000,000 and \$80,000,000 while each interceptor costs around \$50,000. Inna Lazareva, *The Iron Dome: What is It and How Does It Work?* TELEGRAPH (July 10, 2014), <http://www.telegraph.co.uk/news/worldnews/middleeast/israel/10960091/The-Iron-Dome-what-is-it-and-how-does-it-work.html>.

<sup>152</sup> The Iron Dome is currently able to intercept projectiles up to 70 kilometers away from where it is deployed. This is the consequence of both interceptor range and its projectile detection system. Moving the system can result in the suboptimal protection of populated areas.

<sup>153</sup> Article 52(2) of AP I, *supra* note 21, defines military objectives as "objects which by their nature, location, purpose or use make an effective contribution to military action and whose total or partial destruction, capture or neutralization, in the circumstances ruling at the time, offers a definite military advantage."

use” has not been addressed in the literature.<sup>154</sup> Further contributing to the confusion, when interpreting the word “nature” the ICRC Commentary states that “all objects directly used by the armed forces” should be regarded as military objectives.<sup>155</sup> This interpretation places the emphasis on the entity *using* the object, rather than the nature of the object itself.<sup>156</sup> The Commentary seems to suggest that a system’s nature is determined by those (civilians or military personnel) who are using it. Under this understanding of “nature”, IDSs would qualify as military objectives whenever they are operated by military personnel.<sup>157</sup>

Recent scholarship, however, characterizes the ICRC Commentary’s analysis as “misleading, because the nature criterion is not defined by its use.”<sup>158</sup> According to Jachec-Neale, “nature” refers to the inner character of an object and, accordingly, does not change with time.<sup>159</sup> What matters when assessing the nature of an object is its intended application, its functions and designation, and its connection to military operations. To put it simply, “their normal condition is to be used intrinsically for military purposes only.”<sup>160</sup> Intelligent defense systems do not meet this requirement since they, by definition, fulfill a distinctly civilian purpose. Their primary purpose is to protect civilians from war crimes rather than create a military advantage. They cannot be regarded as legitimate targets *by nature* and would instead have to be “judged according to their use.”<sup>161</sup> In light of the absence of consensus, the confusion introduced by the ICRC Commentary, and the difficulty of comparing IDSs to warships, armament factories, and military facilities, we conclude that IDSs do not constitute military objectives *by nature*.

An IDS could also be regarded as a military objective on the basis of its “location,” that is, when it is located in or near a strategic area. As noted by the ICRC Commentary, these objects “which by their nature have no military function but which, by virtue of their location, make an effective contribution to military action.”<sup>162</sup> This could include an observation post, a hilltop, a gathering point, a mountain pass, a jungle trail, and even a house or a piece of land, depending on the circumstances.<sup>163</sup>

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<sup>154</sup> See AGNIESZKA JACHEC-NEALE, *THE CONCEPT OF MILITARY OBJECTIVES IN INTERNATIONAL LAW AND TARGETING PRACTICE* 45 (2015).

<sup>155</sup> See ICRC Commentary, *supra* note 23, para. 2020.

<sup>156</sup> *Id.*

<sup>157</sup> This is true of the Iron Dome in Israel. See Amir Teig & Inbal Orpaz, *Under the Radar, Who Operates the Iron Dome's Nerve Center?*, HAARETZ (Dec. 7, 2012), <http://www.haaretz.com/israel-news/under-the-radar-who-operates-the-iron-dome-s-nerve-center.premium-1.483304>.

<sup>158</sup> JACHEC-NEALE, *supra* note 154, at 47.

<sup>159</sup> *Id.* at 46.

<sup>160</sup> *Id.* at 47.

<sup>161</sup> *Id.* at 48.

<sup>162</sup> ICRC Commentary, *supra* note 23, para. 2021.

<sup>163</sup> See JACHEC-NEALE, *supra* note 154, at 64. See also AMW Manual, *supra* note 139, at 107.

The “location” criteria is particularly challenging in relation to IDSs as they are mobile systems that can be moved relatively easily at the discretion of the state that deploys them. While an IDS located in location *L1* would constitute a military objective, the same IDS might *not* constitute a military objective when deployed in location *L2*. Knowing which IDS constitutes a legitimate target becomes unduly complicated when dozens of IDS batteries are spread over a state’s territory. Moreover, and perhaps more importantly, it is unlikely that the specific location of an IDS would make a significant contribution to military action as IDS are typically deployed in close proximity to civilian populated areas. All in all, the location criterion seems poorly tailored to IDSs.

An IDS may constitute a legitimate target if its use effectively contributes to military action. While “use” refers to the system’s present function, “purpose”—the fourth and last criteria—is typically understood to mean its intended future use.<sup>164</sup> Like location, “purpose” and “use” are dictated in large part by context.

The use of an object can change, and with it, its status. For example, the U.S. military deployed certain Patriot Missile System batteries in the beginning of the Second Gulf War to defend population centers in Kuwait from Iraqi missile attacks.<sup>165</sup> By contrast, also during the Second Gulf War, some Patriot Missile batteries were deployed to protect very large military compounds as well as troop deployments in battle. In the latter case, the purpose and use of the Patriot was strictly to protect military assets—advocating a treatment as a military objective.<sup>166</sup>

This contrasts with IDSs, which, by definition, are developed, purchased, and employed with civilians in mind.<sup>167</sup> This is true even though military objectives could end up within an IDS’s protection area. The Iron Dome, for example, presently has the capability to intercept projectiles between 4 kilometers and 70 kilometers from its deployment location. When an explosive projectile is launched, the Iron Dome predicts where the projectile will land, within a radius known as a “polygon.”<sup>168</sup> This radius, which reportedly covers a few kilometers, could certainly include military objectives as well as civilian ones.<sup>169</sup>

In light of the foregoing, one might be tempted to argue that whenever the polygon includes military targets, the Iron Dome ought to be treated as a military

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<sup>164</sup> See ICRC Commentary, *supra* note 23, paras. 2022-23; AMW Manual, *supra* note 139, at 107.

<sup>165</sup> Mitchell, *supra* note 7.

<sup>166</sup> *Id.*

<sup>167</sup> See *supra* note 2.

<sup>168</sup> This two-kilometer radius is set to evolve as technology evolves.

<sup>169</sup> Inbal Orpaz, Amir Teig & Amitai Ziv, *Meet Israel’s Home-front Hero: Iron Dome*, HAARETZ (July 18, 2014), <http://www.haaretz.com/israel-news/business/.premium-1.605770>. See also Teig & Orpaz, *supra* note 157.

objective itself. Its status would therefore depend on whether the rocket launched by Hamas aimed at a civilian or military target. Conditioning the status of IDSs upon the nature of the assets targeted by the opponent would assume that a state knows or can find out what assets the opponent intended to target. The identification of an object's "purpose," generally understood as intended future use,<sup>170</sup> by speculating as to which assets were targeted is problematic because it infuses doubt in the targeting process.<sup>171</sup> Moreover, just like the system cannot identify with certainty which object is being targeted within a certain radius, the attacker cannot be certain that it will succeed in hitting a military objective within that same radius.

Even if it were possible for the system to identify the intended target in the limited timeframe available,<sup>172</sup> it still would not tell the entire story. The rocket could have been launched at a populated area with the intent of harming civilians, unintentionally threatening a military objective in the process. Or the enemy could have intended to strike a legitimate target but failed to actually do so. Finally—and this is a likely scenario—an incoming projectile might threaten both civilian *and* military targets.

In such cases, IDSs could arguably qualify as dual-objectives, namely military objectives that are used *simultaneously* for military and civilian purposes. However, even if and when IDSs indirectly provide protection to military targets within the polygon, the nature of the military function they thereby fulfill is unlikely to rise to the threshold needed for a primarily civilian object to be regarded as a military objective.<sup>173</sup>

Ultimately, in our view both "purpose" and "use" point to the role played by IDSs on the battlefield—a role dramatically different from traditional military objectives. As systems designed to counter discriminate and indiscriminate attacks on civilians, IDSs advance a unique humanitarian function that should be acknowledged by the law. Instead, the tight connection between IDSs and the military, combined with the military advantage that would be gained from the destruction or neutralization of an IDS, contribute to the perception of IDSs as military objects. This analysis, no matter how intuitive, is flawed because it disregards the humanitarian purpose of IDSs.

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<sup>170</sup> See ICRC Commentary, *supra* note 23, para. 2022.

<sup>171</sup> See JACHEC-NEALE, *supra* note 154, at 77 ("Bearing in mind that the intent of the defending party is not usually readily available to the adversary, such evaluations could be speculative, thereby leaving the attacker with some degree of doubt."); AMW Manual, *supra* note 139, at 107 (noting that when the enemy's intent is not clear "it is necessary to avoid sheer speculation and to rely on hard evidence, based perhaps on intelligence gathering.").

<sup>172</sup> The Iron Dome must intercept enemy projectiles as early as 10 seconds after the projectile is launched. See *Rocket and Population Map*, ISRAEL DEFENSE FORCES BLOG (Jan. 21, 2009), <https://www.idfblog.com/blog/2009/01/21/rocket-and-population-map-21-jan-2009/>.

<sup>173</sup> See JACHEC-NEALE, *supra* note 154, at 69 ("[T]he issue is not that there is a requirement for a sufficient volume of military use, but whether the use is of military quality such as to take it across the threshold.").

Overall, a review of the four non-cumulative criteria reveals that IDSs are unlikely to be regarded as military objectives by virtue of their nature, location, use, or purpose.<sup>174</sup> It is thus unnecessary to analyze the second element of the definition of military objective—whether the object’s “total or partial destruction, capture or neutralization, in the circumstances ruling at the time, offers a definite military advantage” under Article 52 of Additional Protocol I.

Notwithstanding our finding that IDSs are unlikely to meet the definition of military objective, we argue that they should belong to an entirely distinct and protected legal category: civil defense.<sup>175</sup> Taking a more active stance on IDSs would not only encourage their use, it would also further IHL’s very *raison d’être*.

### E. *IDSs as Civil Defense: A Remnant of the Past or the Way of the Future?*

Legal scholars have neglected the concept of civil defense as a topic of valuable, relevant exploration for modern conflict<sup>176</sup>; virtually no contemporary scholarship has been produced regarding the meaning or operational value of civil defense.<sup>177</sup> Yet our analysis suggests that the legal framework governing civil defense—contained in Articles 61 to 67 of Additional Protocol I—provides valuable insight in the context of defense systems.

#### 1. The Concept of Civil Defense Under IHL

Although civil defense has been said to have its roots in the Hague Regulations of 1899 and 1907,<sup>178</sup> the concept of civil defense was not clearly formulated until the adoption of Fourth Geneva Convention in 1949. Article 63 provides that:

Subject to temporary and exceptional measures imposed for urgent reasons of security by the Occupying Power:

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<sup>174</sup> It should be noted that the criteria are widely regarded as overlapping and being much less relevant in practice than in theory. *See* JACHEC-NEALE, *supra* note 154, at 81; AMW Manual, *supra* note 139, para. 2 (“As a practical matter, attacks are most commonly based on an object’s nature (generally the enemy’s military equipment or installation) or by use by the enemy; qualification by purpose (the enemy’s intended future use of an object) or location is less common.”).

<sup>175</sup> Others might advocate the creation of an entirely new category for IDSs. This Article prefers to find a solution in the existing, unused, and highly relevant protection afforded to civil defense tasks.

<sup>176</sup> *See* AP I, *supra* note 21, arts. 61-67.

<sup>177</sup> A notable exception is BOŠKO JAKOVLJEVIĆ, *NEW INTERNATIONAL STATUS OF CIVIL DEFENCE: AS AN INSTRUMENT FOR STRENGTHENING THE PROTECTION OF HUMAN RIGHTS* (1982).

<sup>178</sup> *See* ICRC, *CIVIL DEFENCE, FROM LAW TO PRACTICE, REPORT FROM THE MEETING OF EXPERTS I* (1997) [hereinafter “ICRC Report on Civil Defense”] (citing to arts. 23, 26, 28, 43 and 46 of the 1899 Hague Regulations).



(a) recognized National Red Cross (Red Crescent, Red Lion and Sun) Societies shall be able to pursue their activities in accordance with Red Cross principles, as defined by the International Red Cross Conferences. Other relief societies shall be permitted to continue their humanitarian activities under similar conditions;

(b) the Occupying Power may not require any changes in the personnel or structure of these societies, which would prejudice the aforesaid activities.

The same principles shall apply to the *activities and personnel of special organizations of a non-military character, which already exist or which may be established, for the purpose of ensuring the living conditions of the civilian population by the maintenance of the essential public utility services, by the distribution of relief and by the organization of rescues.*<sup>179</sup>

Article 63 was included into the Fourth Geneva Convention primarily to enable the International Committee of the Red Cross (“ICRC”) and other groups concerned with upholding humanitarian services to operate safely in situations of occupation.<sup>180</sup> This objective was directly related to the substantial issues that civil defense organizations faced during World War II, where occupying powers often prevented the carrying-out of their activities.<sup>181</sup> To this end, Article 63 can be seen as constituting “the first evidence of international recognition of the right of civil defense organizations to legal protections.”<sup>182</sup>

In 1977, the ICRC decided that this concept needed to be expanded to situations beyond occupation, thus it attempted to convince states to establish a special protective status for people, organizations, objects, and systems engaged in the protection of civilian populations during armed conflicts *in general*. The ICRC’s efforts paid off, as Articles 61 to 67 of Additional Protocol I consecrated civil defense as a protected category of objects and persons under international law: “[i]t is of the same legal nature as the immunity of medical and health services, and similar to that of cultural property under special protection.”<sup>183</sup> Specifically, civil defense organizations resemble medical organizations in that

<sup>179</sup> Emphasis added.

<sup>180</sup> See ICRC, *supra* note 178.

<sup>181</sup> JAKOVLJEVIĆ, *supra* note 177, at 6.

<sup>182</sup> Stéphane Jeannet, *Civil Defense: 1977-1997 from Law to Practice*, 38 INT’L REV. OF THE RED CROSS 715 (1998).

<sup>183</sup> *Id.* at 16; see also AMW Manual, *supra* note 139, at 212 (“Specific protection is granted to civilian civil defence organizations, personnel, buildings and material because of their function.”).

both enjoy a protected status under IHL, may lose such status in certain circumstances,<sup>184</sup> and must display a distinctive sign.<sup>185</sup>

Article 61 of Additional Protocol defines civil defense as "the performance of some or all of the under-mentioned humanitarian tasks intended to protect the civilian population against the dangers, and to help it to recover from the immediate effects, of hostilities or disasters and also to provide the conditions necessary for its survival." Article 63 also lists the following fourteen tasks as constituting civil defense tasks: warning, evacuation, the management of shelters, the management of blackout measures, rescue, medical services including first aid and religious assistance, fire-fighting, detection and marking of danger areas, decontamination and similar protective measures, provision of emergency accommodation and supplies, emergency assistance in the restoration and maintenance of order in distressed areas, emergency repair of indispensable public utilities, emergency disposal of the dead, and assistance in the preservation of objects essential for survival. Article 61 demands that civil defense tasks fit within at least one of the fourteen enumerated activities.<sup>186</sup> It also contemplates a broad fifteenth category, namely "complementary activities necessary to carry out any of the tasks mentioned" as civil defense.<sup>187</sup>

As both the long list and the fifteenth category make clear, Additional Protocol I significantly broadened the activities that qualify for civil defense status by allowing the definition to apply beyond occupation.<sup>188</sup> The fifteenth and broadest category is the result of an important compromise made during the drafting of the Article, as states initially could not agree on whether civil defense tasks should be listed and, if so, whether the list should be considered exhaustive.<sup>189</sup> Eventually, states decided to include an open-ended fifteenth category of "complementary activities" which gives expression to states' changing strategic needs and allows civil defense tasks to evolve as technology makes new advances.<sup>190</sup> Civil defense organizations can embrace technological advances that better serve their humanitarian aims without compromising the

<sup>184</sup> See AP I, *supra* note 21, art. 65.

<sup>185</sup> *Id.*, art. 66; JAKOVLJEVIĆ, *supra* note 177; AMW Manual, *supra* note 139, at 193 ("they are to be respected and protected from the they have been identified as such, even if they do not display the international distinctive sign.").

<sup>186</sup> AP I, *supra* note 21, art. 61 (listing as civil defense tasks "(i) warning; (ii) evacuation; (iii) management of shelters; (iv) management of blackout measures; (v) rescue; (vi) medical services, including first aid, and religious assistance; (vii) fire-fighting; (viii) detection and marking of danger areas; (ix) decontamination and similar protective measures; (x) provision of emergency accommodation and supplies; (xi) emergency assistance in the restoration and maintenance of order in distressed areas; (xii) emergency repair of indispensable public utilities; (xiii) emergency disposal of the dead; (xiv) assistance in the preservation of objects essential for survival; (xv) complementary activities necessary to carry out any of the tasks mentioned above, including, but not limited to, planning and organization.").

<sup>187</sup> *Id.*

<sup>188</sup> See JAKOVLJEVIĆ, *supra* note 177.

<sup>189</sup> *Id.*

<sup>190</sup> See Jeannot, *supra* note 182.

protection to which they are entitled. Overall, the open-ended clause affords enough flexibility to efficiently meet civil defense needs while preventing civil defense from being interpreted too broadly.

Upon closer scrutiny, Articles 61–67 of Additional Protocol I are further divided by their nature: while Articles 62–66 address civilian civil defense organizations, Article 67 deals with military civil defense organizations. This division, critical at the time of drafting, has become difficult to implement on a battlefield where lines between civilian and military have significantly eroded.<sup>191</sup> Perhaps this explains why states and international organizations have often chosen not to take advantage of civil defense protections in contemporary conflicts. Yet the development of intelligent defense systems like Iron Dome has made civil defense status relevant in today's conflicts.

This comes as a change, as civil defense has attracted little attention since the adoption of Additional Protocol I. Even the ICRC, for whom civil defense once held immense importance, chose not to address the topic in its Study on Customary and International Humanitarian Law. In the introduction, the Study acknowledges that “[a] number of topics could not be developed in sufficient detail for inclusion in this edition, but they might be included in a future update. These include, for example, the Martens clause, the identification of specifically protected persons and objects, and civil defence.”<sup>192</sup> One scholar has noted that civil defense was omitted from the study because it is uncontroversial.<sup>193</sup> Still, it would have been helpful to hear, *inter alia*, the views of the ICRC on the customary nature of Articles 61–67 of Additional Protocol I.<sup>194</sup>

State practice suggests that many states have adopted the concept of civil defense in their military manuals, including the Netherlands,<sup>195</sup> Germany,<sup>196</sup> Russia,<sup>197</sup> and El Salvador.<sup>198</sup> The U.S. Department of Defense Law of War Manual, too, acknowledges the unique status of civil defense tasks.<sup>199</sup> However,

<sup>191</sup> See JAKOVLJEVIĆ, *supra* note 177, at 58–63; AMW Manual, *supra* note 139 (reiterating this distinction in Rule 90).

<sup>192</sup> 1 JEAN-MARIE HENCKAERTS & LOUISE DOSWALD-BECK, *CUSTOMARY INT’L HUM. L.* 29 (2005).

<sup>193</sup> Yoram Dinstein, *The ICRC Customary International Humanitarian Law Study*, 82 INT’L L. STUD. SER. US NAVAL WAR COL. 99, 100 (2006).

<sup>194</sup> Valuable insights can be gained in this respect from the AMW Manual, *supra* note 139, which addresses civil defense at length in its Section N.

<sup>195</sup> MIL. MAN. NETHERLANDS, p. V-12, § 10.

<sup>196</sup> GERMANY, MIL. MAN. (1992), § 520.

<sup>197</sup> The Report on the Practice of Russia states that members of the armed forces and military units assigned to civil defense organizations should be respected and protected if their activities comply with the relevant provisions of IHL. 646 REPORT ON THE PRACTICE OF RUSSIA, 1997, Chapter 4.2.

<sup>198</sup> See ICRC Report on Civil Defense, *supra* note 178, paras. 415-16.

<sup>199</sup> U.S. DEP’T OF DEFENSE, LAW OF WAR MANUAL 172, 4.22 (June 12, 2015) (“The United States has supported the principle that civilian civil defense organizations and their personnel be respected and protected as civilians and be permitted to perform their civil defense tasks except in cases of imperative military necessity.”).

according to the Manual, the provisions of Additional Protocol I relating to civil defense do not preclude an attack “on an otherwise lawful military objective.”<sup>200</sup> This could be interpreted as allowing a strike against a civil defense task if such a task otherwise meets the definition of a military objective. In our view, this interpretation would run afoul of the very purpose of civil defense, namely to create a protected category distinct from the civilian/military *summa divisio*. While the destruction or neutralization of a civil defense task may at times offer a military advantage, it does not turn the object into a military objective. That said, turning civil defense tasks into military objectives may not be what the U.S. is after. The Manual adds that “[t]o lessen the risk of misuse of the sign and avoid placing an unacceptable burden on proof of an attacking force, an understanding is proposed that makes it clear that Articles 61–67 do not preclude an attack on an otherwise lawful military objective.”<sup>201</sup> It could be that the Manual merely seeks to avoid abuses of the civil defense label, especially when such abuses would severely impede military operations.<sup>202</sup>

## 2. Civil Defense and IDSs

We argue that Intelligent Defense Systems should be regarded as civil defense as they embody civil defense’s *raison d’être*: they “provide the conditions necessary for [the population]’s survival,” as set forth in Article 61.<sup>203</sup>

Specifically, IDSs could be regarded as providing “assistance in the preservation of objects essential for survival” under the fourteenth task listed in Additional Protocol I. They help protect hospitals, schools, and civilian populated areas. It should be noted that the term “essential” was chosen specifically to broaden the scope of civilian objects already protected under Article 54, as “objects indispensable to the survival of the civilian population.”<sup>204</sup> Just as more traditional civil defense tasks, such as air-raid sirens or bomb shelters, may protect civilians from aerial bombardment, an IDS offers similar (and arguably more efficient) protection to essential objects.

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<sup>200</sup> *Id.*

<sup>201</sup> *Id.* § 461.

<sup>202</sup> Because the rules governing civil defense are contained in Additional Protocol I regulating international armed conflict, a question arises as to the status of civil defense in non-international armed conflict. Although the ICRC and a number of states have expressed the wish to have the rules expanded to non-international armed conflicts, the question remains unresolved. *See* ICRC Report on Civil Defense, *supra* note 178; AMW Manual, *supra* note 139, at 208 (“Treaties applicable in non-international armed conflict contain no special provisions for civil defense. However, civilian civil defense organizations and their personnel, the building and materiel used for civil defense purposes, and shelters provided for the civilian population benefit from the generic protection granted to civilians and civilian objects. . . . Military personnel discharging civil defense duties must also be protected in non-international conflicts, provided they do not directly participate in hostilities.”).

<sup>203</sup> *See* AP I, *supra* note 21, art. 61.

<sup>204</sup> *See* ICRC Commentary, *supra* note 23, paras. 2400–02.

IDSs also contribute to the protection of the population in terms of the warning, evacuation, and management of shelters (listed as tasks (I) to (IV)). Zucker and Kaplan, interestingly, measure the impact of Iron Dome alongside shelters, fortified rooms, and alarms in what they collectively refer to as “intensive civil defense measures.”<sup>205</sup>

Finally, IDSs could be regarded as performing an activity “complementary to carry out” other civil defense tasks, as suggested in the open-ended fifteenth category of civil defense tasks.

To summarize, IDSs likely meet all three criteria—assistance in the preservation of objects essential for survival, warning and the management of shelters, and an activity complementary to other civil defense tasks—any one of which is sufficient to obtain the protected status of civil defense. Still, treating IDSs as civil defense is likely to raise objections.

First, skeptics might argue that the missile interceptor component of an IDS precludes a characterization as civil defense. This line of reasoning is flawed for multiple reasons. Even though they do employ kinetic force against incoming projectiles, IDSs in many, if not most, operational contexts do not function as weapons. Additionally, IHL does not specify what defines a system or component of a system as a weapon. Even if the missile interceptor component were to be regarded as a weapon, it would not affect the characterization of IDSs (as a whole) under the law.

Second, one could argue that the destruction or neutralization of IDSs would provide a military advantage to the enemy—effectively turning IDSs into military objectives under Article 52 of Additional Protocol I (assuming that it meets the other requirements of Article 52, which we strongly dispute). Our analysis shows that IDSs are not different in this respect than other civil defense tasks. Take, for example, shelters and warning systems: their destruction or neutralization would certainly offer a military advantage to the enemy. By creating a special layer of protection for civil defense tasks, IHL purposefully excluded such targets from the military objective category. Regardless of whether they might have otherwise qualified as military objectives, IHL took these objects out of the civilian/military equation. We argue that IDSs tasks, like other protected civil defense tasks, belong to this category.

Third, one might find it difficult to accept that an IDS could remain protected even while protecting military objectives. This objection, which we touched on in Section 3, is addressed by taking a closer look at civil defense protection. Under the civil defense rules, the system could intercept a projectile aimed at civilian *and* military personnel without jeopardizing its protective civil

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<sup>205</sup> Lian Zucker & Edward Kaplan, *Mass Casualty Potential on Kassam Rockets*, 37 STUDIES IN CONFLICT & TERRORISM 258, 259 (2014) (arguing that the layered civil defense measures put in place by Israel have prevented injury and saved civilian lives).

defense status. According to the ICRC commentary, “it is especially at the moment when a mission is assigned that it should be determined whether this mission does or does not fall under the definition of civil defense.”<sup>206</sup> Once conceptualized as civil defense, civil defense systems keep this status even as they serve limited non-civilian roles. This leniency was given to civil defense because doing so best protects the underlying humanitarian function of civil defense—namely “the protection of the civilian population against the dangers, and to help it recover from the immediate effects, of hostilities and to provide the conditions necessary for its survival.”<sup>207</sup> The most critical element in determining what constitutes civil defense is the purpose behind the task in question. The ICRC Commentary illustrates this point by using fire-fighting as an example: “a fire in a military objective can actually endanger the lives of able-bodied civilians or of wounded soldiers or of civilians who happen to be in the vicinity.”<sup>208</sup> According to the Commentary, the fire-fighting task must still be treated as civil defense since it is undertaken with a view of protecting civilians and military personnel hors de combat and preventing damage to civilian objects.<sup>209</sup>

The case of “warning”—a task defined by Additional Protocol I as civil defense—further illustrates this point. Ideally, an air-raid siren should be placed where it can be heard by the highest percentage of a city’s civilians. Quite possibly, the air-raid siren will also be audible from a nearby military base. The siren does not lose its special civil defense protection even though it may simultaneously be used to alert the military base of an imminent threat. This is because it is the purpose of these tasks, “giving right to protection if they are undertaken for the benefit of civilian population, regardless of whether at the same time they may benefit members of the armed forces. The humanitarian purpose has prevailed.”<sup>210</sup>

In other words, the *lex lata* acknowledges and embraces complex situations where civil defense may provide protection to both civilians and combatants. This resonates well in the context of IDSs, which have the ability to engage and intercept multiple projectiles simultaneously. What if some of these rockets pose threats to military objectives *as well as* civilian objectives? As the Commentary’s example on fire-fighting indicates, an IDS would retain its special protection as civil defense even in these complex situations—provided it has already obtained civil defense status.

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<sup>206</sup> See ICRC Commentary, *supra* note 23, para. 2416.

<sup>207</sup> AP I, *supra* note 21, art. 61.

<sup>208</sup> *Id.*, para. 2378.

<sup>209</sup> *Id.*, para. 2376. In one last twist in the scenario, one might wonder whether the ICRC would have reached a different conclusion if the incoming rocket was threatening exclusively combatants. It is important to reiterate that, under our analysis, this does not actually matter, as we do not know with precision what is the (intended) target of an incoming missile or whether IDSs will ever have the capability to predict the trajectory of a rocket with this level of accuracy.

<sup>210</sup> JAKOVLJEVIĆ, *supra* note 177, at 26.

A fourth concern with IDSs classification as a civil defense system comes from the role of the military in its implementation and operation.<sup>211</sup> The military's involvement raises potential issues of qualification (such as whether an IDS can be operated by military personnel without turning into a military objective) and distinction (a soldier assigned to an IDS could be perceived as taking advantage of his or her protected status or unlawfully blurring the lines between the civilian and military spheres).<sup>212</sup>

A closer analysis of the rules governing civil defense helps to overcome these issues. The law on civil defense expressly contemplates the operation of civil defense tasks by military personnel provided they are exclusively and permanently assigned to tasks of civil defense; they do not perform any other military duty or take a direct part in hostilities for the duration of the conflict; they are clearly distinguishable from other members of the armed forces; they are equipped only with light weapons; and they operate only on their own territory.<sup>213</sup>

At a time where states increasingly fold civil defense tasks under civilian organizations – particularly Western states that have both the financial capability and manpower to manage civil defense tasks separately from the military<sup>214</sup> – it is important to emphasize that the assignment of military personnel to civil defense tasks is neither regarded as a challenge to qualification nor to distinction. As noted by the Commentary, the law “implicitly authorizes the attachment of military personnel to civilian defence organizations, but there is nothing prevent the organizations themselves from belonging to the armed forces, provided of course that the conditions listed in [Article 67] are met.”<sup>215</sup>

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<sup>211</sup> This point was touched on in *id.*, at 58.

<sup>212</sup> See ICRC Report on Civil Defense, *supra* note 178.

<sup>213</sup> AP I, *supra* note 21, art. 67; see also AMW Manual, *supra* note 139, Rule 90. The protection of military civil defense organizations was heavily debated at the time of drafting. Some delegations argued that protection to those carrying out civil defense tasks should be independent of their military or civilian status, and pointed out the necessity to allow military personnel to do so in countries where qualified civilian personnel are too scarce (ICRC Commentary, *supra* note 23, para. 2706). Others worried that distinguishing between military personnel assigned to civil defense from other military personnel would be too difficult, with the risk that this would impede civil defense tasks (*id.*, para. 2707). The disagreement was such that a sub-Working Group was assigned to this specific question. It decided to devote a special article to members of the armed forces and military units assigned to civil defense organizations and establish special rules for them (*id.*, para. 2710).

<sup>214</sup> ICRC Report on Civil Defense, *supra* note 178, Point 1 (noting that while developing countries still have civil defense carried out by military forces, a number of developed countries have folded civil defense tasks under civilian organizations). Nevertheless, because IDSs are incredibly expensive and require an enormous amount of highly specified training, they are likely to remain under military control in the long run.

<sup>215</sup> ICRC Commentary, *supra* note 23, paras. 2712.

Finally, one might argue that a treatment of IDSs as civil defense actually runs counter to states' interests.<sup>216</sup> Two nations, both possessing IDSs, would certainly wish to target each other's IDSs during armed conflict. This objection takes for granted a number of assumptions that need to be considered carefully. It is unlikely that two nations using the type of indiscriminate weapons that would justify the use of an IDS would also both possess an IDS. As of today, no two states possessing IDSs have used such systems in a war pitting them against each other—though this might happen in the future, particularly as India and South Korea contemplate the purchase of Iron Dome batteries and develop their own IDSs to counter the threats from Pakistan and North Korea, respectively.<sup>217</sup> The objection also assumes that states would not hesitate to order a strike against an IDS. We are unsure about this. Would a law-abiding state really see no objection—moral or otherwise—in destroying a system used to protect civilians? Even assuming that the system's status is unclear or, worse yet, that it is regarded as a military objective, a state might still refrain from targeting for reasons that go beyond the law. Incidentally, granting IDSs special protection would ensure that any attack on an IDS would constitute a war crime.<sup>218</sup>

To summarize, none of the objections to a treatment of IDSs as civil defense are convincing. We see no intrinsic legal barriers that would prevent IDSs from obtaining civil defense status, particularly if users make clear that the purpose of the system is to protect the civilian population.<sup>219</sup> The rationale behind the development and use of intelligent defense systems echoes the intention of the drafters of Article 61. The latter even acknowledged that technology would give rise to novel means of providing civil defense—and gave expression to this possibility in the Article itself. IHL clearly values civil defense, and gave it a broad and functional scope. As a matter of policy, IHL did not impose any positive obligation on states to undertake civil defense tasks but it does encourage states to make shelters available or train civil defense teams as part of their duty to protect the civilian population against the effects of attacks.<sup>220</sup> These incentives are reinforced by the special protection afforded to civil defense tasks and teams—even if civil defense tasks do at times protect non-civilian objectives and

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<sup>216</sup> We are indebted to Michael Schmitt for this point.

<sup>217</sup> David Refaeli, *Behind the Stage of the Iron Dome: Obstacles along the Way and 90% Success*, CALCALIST (July 14, 2014) (in Hebrew, free translation).

<sup>218</sup> One might wonder whether such considerations actually matter in practice. We agree that the treatment of IDSs as civil defense might not affect the behavior of the non-compliant actor (though there might be a difference in perception between launching rockets indiscriminately and specifically targeting a protected object). Our view is that a treatment of IDSs as civil defense will at least convey the right message to states contending with indiscriminate attacks by incentivizing their use when all other means have failed to put an end to the other side's violation. That message will be consistent with IHL's underlying values. *See also supra* note 15.

<sup>219</sup> This could easily be achieved, especially for states that already have the data relevant to their specific threats. Israel, for example, noted that the Iron Dome shot down 84% of projectiles threatening populated areas. *See, e.g.*, Uzi Rubin, *Rockets versus Missiles in the Second Gaza War*—Washington Institute for Near East Policy Lecture, Washington D.C., (Dec. 19, 2012).

<sup>220</sup> *See* AP I, *supra* note 21, art. 58; ICRC Commentary, *supra* note 23, paras. 2258–59.



even if these tasks are provided by the military itself. These incentives seem to emulate what we regard as the proper conceptualization of intelligent defense systems under IHL: IHL should not require states to develop or employ IDSs but nonetheless must incentivize their use.

### Conclusion

Contemporary conflicts have increased the demand for intelligent defense systems. This is because IDSs successfully defend against indiscriminate attacks and consequently afford greater military flexibility, all without causing civilian death. Or, to put it differently, IDSs can do what IHL has failed to achieve: “correct” non-compliance with international law by one of the belligerents.

Given the breadth of the issues that arise from the use of intelligent defense systems, it is surprising that they have not attracted more attention from legal and international relations scholars. Both the black-letter law and international legal scholarship remain thin on the conceptualization of intelligent defense systems under IHL. Similarly, international relations scholars have not investigated the impact of intelligent defense systems (as defensive apparatus) on security. This Article thus offers the very first discussion of legal and security issues surrounding the development and use of intelligent defense systems.

We chose to tackle two specific questions arising from the development and use of intelligent defense systems:

First, we exposed the challenges IDSs pose to the law. IHL, as a body of law governing war, places a strong emphasis on obligations owed by a belligerent to the enemy—both to enemy civilians and enemy combatants—in order to minimize the harm caused to civilians in times of war. Few norms of IHL address obligations owed by states to their own civilians and combatants (we call these “reflexive” obligations). For example, IHL does not clearly posit how the harm caused to one’s soldiers should factor into the proportionality calculus. Similarly, IHL does not provide much guidance on how states may engage in the protection of their own civilians. If they have the ability to place their civilian population out of harm’s way, are states under an obligation to do so? We argue that IHL’s difficulties in conceptualizing IDSs can be attributed to the “causative” approach taken by this body of law—with little, if any, concern for reflexive obligations. Because intelligent defense systems are designed to protect one’s *own* civilians from the dangers of warfare, they challenge humanitarian law’s prevailing logic.

IDSs place humanitarian law in a bind for an additional, no less important reason. IDSs create a paradox for international humanitarian law: regardless of the position IHL takes vis-à-vis intelligent defense systems, it will necessarily suffer some loss of legitimacy and cause some escalation on the battlefield. On the one hand, IHL cannot but encourage the use of systems designed to protect civilians—particularly given its failure to create real incentives for non-compliant actors to abide by the law. On the other hand, by encouraging the use of defense systems,

IHL implicitly abdicates responsibility for the non-compliant behavior of rogue actors and fails to discourage non-compliant behavior in the future. For reasons grounded in IHL itself, offense-defense theory, and data analysis on Iron Dome, we suggest that IHL should nevertheless incentivize intelligent defense systems.

Second, we tackled the question of how IHL should conceptualize intelligent defense systems. IDSs neither qualify as weapons nor as military objectives under humanitarian law. Because they combine elements of civilian protection with a strong military nexus (the systems are usually developed and operated by the military), IDSs do not fit neatly within the civilian/military category. An in-depth analysis of the little-known concept of civil defense shows that its rationale—to afford absolute protection to those specifically assigned to protect the civilian population, even if they are members of the armed forces—is much better suited to IDSs and furthers the policy-oriented objective of incentivizing the use of IDSs.

## IRON DOME ARMED CONFLICT DATA APPENDIX

This appendix lists all the sources used to compile the Iron Dome Armed Conflict Data, variable by variable. Variable data that were formulated through an equation or estimation is explicitly explained herein.

### Duration of Conflict

1. 2006 Second Lebanon War: Rubin, U. (2007). *The Rocket Campaign against Israel during the 2006 Lebanon War*. Begin-Sadat Center for strategic Studies, Bar-Ilan University. This article cites the war as lasting 31 days. In a 2011 article Uzi Rubin publishes, he notes the length of the war lasting 33 days. Rubin, U. (2011). *The Missile Threat from Gaza: From Nuisance to Strategic Threat*. Begin-Sadat Center for Strategic Studies. The difference is the result of a ceasefire which we include in the length of the conflict duration, thus arriving at 33 days.
2. 2008-2009 Operation Cast Lead: Rubin, U. (2011). *The Missile Threat from Gaza: From Nuisance to Strategic Threat*. Begin-Sadat Center for Strategic Studies. This article cites the conflict duration at 22 days.
3. 2012 Operation Pillar of Defense: Shapir, Y. S. (2013). Lessons from the Iron Dome. *Military and Strategic Affairs*, 5. This article notes the duration of the conflict as 8 days in length.
4. 2014 Operation Protective Edge: Shamir, E. (2015). Rethinking Operation Protective Edge. *Middle East Quarterly*. This article cites the length of the war was 50 days.

### Total Rockets Launched

Various statistics have been published for the total number of rockets launched. They typically do not differentiate between the use of mortars and rockets—even though the Iron Dome has lower interception rates against mortars. Furthermore, it is possible that rockets fired into unpopulated areas may not have been discovered and counted. Ultimately we have decided to use a quoted number that falls under the higher end of the variety of data that is public information for each of the conflicts.

1. 2006 Second Lebanon War: Rubin, U. (2007). *The Rocket Campaign against Israel during the 2006 Lebanon War*. Begin-Sadat Center for strategic Studies, Bar-Ilan University. Rubin notes that rocket figures have been quoted from 3970 to 4200. For the purpose of this paper we use the 4200 statistic as this is closest to the figures most frequently quoted by a multitude of sources.

2. 2008-2009 Operation Cast Lead: Rubin, U. (2011). *The Missile Threat from Gaza: From Nuisance to Strategic Threat*. Begin-Sadat Center for Strategic Studies. This article cites the number of rockets fired at 660.
3. 2012 Operation Pillar of Defense: Shapir, Y. S. (2013). Lessons from the Iron Dome. *Military and Strategic Affairs*, 5. This article notes the number of rockets launched as 1506.
4. 2014 Operation Protective Edge: Shapir, *supra* note 16. This article cites the number of rockets fired at 4500.

### **Rockets per Day (Avg.)**

Some scholars note that rockets are not fired at a constant daily rate throughout a conflict. Specifically, Uzi Rubin notes that during the final day or two of conflict, a dramatic increase in rocket fire occurs. See Rubin, U. (2011). *The Missile Threat from Gaza: From Nuisance to Strategic Threat*. Begin-Sadat Center for Strategic Studies. Ultimately, we do not have consistent data for daily rocket fire. We have chosen to measure rocket fire out as a daily average to make a more meaningful and generalizable statistic. This is done by dividing the "Total Rockets Launched" by the Duration of Conflict (Days) – both of which are cited above. See appropriate appendix category for specific citations.

### **Rocket Accuracy**

Most of these numbers are directly cited from sources. However, rocket accuracy – in terms of percentage targeting populated areas in Israel or specific targets of value – was unavailable for 2014 Operation Protective Edge. What we were able to cite is "Rockets Targeting Populace" which we then divided by total rockets launched to derive rocket accuracy. Again, this was only done for a single case (2014 Operation Protective Edge).

1. 2006 Second Lebanon War: Rubin, U. (2007). *The Rocket Campaign against Israel during the 2006 Lebanon War*. Begin-Sadat Center for strategic Studies, Bar-Ilan University. Rubin cites this figure as 23%.
2. 2008-2009 Operation Cast Lead: See Gabi Siboni, *supra* note 69. This statistic is cited as 30%.
3. 2012 Operation Pillar of Defense: See Gabi Siboni, *supra* note 69. This statistic is cited as 32%.
4. 2014 Operation Protective Edge: This statistic, 21%, was calculated as explained above. Please see appendix for "Total Rockets Launched" and "Rockets Targeting Populace" for specific citations.

### Rockets Targeting Populace

Most of these numbers are directly cited from sources. However, rockets targeting populace for 2008-2009 Operation Cast Lead was not cited in previous works. We have used "Total Rockets Launched" and multiplied it by the "Rocket Accuracy" percentage to achieve this statistic.

1. 2006 Second Lebanon War: Rubin, U. (2007). *The Rocket Campaign against Israel during the 2006 Lebanon War*. Begin-Sadat Center for strategic Studies, Bar-Ilan University. This statistic is 907 rockets.
2. 2008-2009 Operation Cast Lead: This statistic is 198. It was calculated as explained above. Please see appendix for "Total Rockets Launched" and "Rocket Accuracy" for specific citations.
3. 2012 Operation Pillar of Defense: Shapir, Y. S. (2013). Lessons from the Iron Dome. *Military and Strategic Affairs*, 5. This article notes the statistic as 479.
4. 2014 Operation Protective Edge: Shapir, *supra* note 16. This statistic is 960.

### Rocket Distances

These figures refer to the furthest possible distance of the rockets used by Hezbollah or Hamas during each armed conflict. Hezbollah claimed that it possessed Iranian rockets that could have targeted cities deep into in Israel but these rockets were not used in the 2006 Second Lebanon War. Rubin, U. (2007). *The Rocket Campaign against Israel during the 2006 Lebanon War*. Begin-Sadat Center for strategic Studies, Bar-Ilan University.

1. 2006 Second Lebanon War: Rubin, U. (2007). *The Rocket Campaign against Israel during the 2006 Lebanon War*. Begin-Sadat Center for strategic Studies, Bar-Ilan University. The statistic is 90-100km.
2. 2008-2009 Operation Cast Lead: Van Esveld, B. (2009). *Rockets from Gaza: Harm to Civilians from Palestinian Armed Groups' Rocket Attacks*. Human Rights Watch. The statistic is 45km.
3. 2012 Operation Pillar of Defense: Shapir, Y. S. (2013). Lessons from the Iron Dome. *Military and Strategic Affairs*, 5. The statistic is 90km.
4. 2014 Operation Protective Edge: See Gabi Siboni, *supra* note 69. The statistic is 160km.

### Total Israeli Fatalities

1. 2006 Second Lebanon War:

<http://mfa.gov.il/MFA/AboutIsrael/History/Pages/Hizbullah%20attack%20in%20northern%20Israel%20and%20Israels%20response%2012-Jul-2006.aspx>. Total fatalities are 162.

2. 2008-2009 Operation Cast Lead:

[http://mfa.gov.il/MFA/ForeignPolicy/Terrorism/Pages/IDF\\_soldiers\\_killed\\_Operation\\_Cast\\_Lead.aspx](http://mfa.gov.il/MFA/ForeignPolicy/Terrorism/Pages/IDF_soldiers_killed_Operation_Cast_Lead.aspx). Total fatalities are 13.

3. 2012 Operation Pillar of Defense:

[http://mfa.gov.il/MFA/ForeignPolicy/Terrorism/Pages/Israel\\_under\\_fire-November\\_2012.aspx](http://mfa.gov.il/MFA/ForeignPolicy/Terrorism/Pages/Israel_under_fire-November_2012.aspx). Total fatalities are 6.

4. 2014 Operation Protective Edge:

<http://mfa.gov.il/ProtectiveEdge/Documents/2014GazaConflictFullReport.pdf>. Total fatalities are 72.

### **Israeli Civilian Rocket Fatalities**

1. 2006 Second Lebanon War:

<http://mfa.gov.il/MFA/AboutIsrael/History/Pages/Hizbullah%20attack%20in%20northern%20Israel%20and%20Israels%20response%2012-Jul-2006.aspx>. Total fatalities are 44.

2. 2008-2009 Operation Cast Lead:

[http://mfa.gov.il/MFA/ForeignPolicy/Terrorism/Pages/IDF\\_soldiers\\_killed\\_Operation\\_Cast\\_Lead.aspx](http://mfa.gov.il/MFA/ForeignPolicy/Terrorism/Pages/IDF_soldiers_killed_Operation_Cast_Lead.aspx). Total fatalities are 4.

3. 2012 Operation Pillar of Defense:

[http://mfa.gov.il/MFA/ForeignPolicy/Terrorism/Pages/Israel\\_under\\_fire-November\\_2012.aspx](http://mfa.gov.il/MFA/ForeignPolicy/Terrorism/Pages/Israel_under_fire-November_2012.aspx). Total fatalities are 4.

4. 2014 Operation Protective Edge:

<http://mfa.gov.il/ProtectiveEdge/Documents/2014GazaConflictFullReport.pdf>. Total fatalities are 6. Only two of these died as a result of rocket attacks (the other two died from mortar attacks). See Shapir, *supra* note 16, at 45. The statistic is therefore 2 fatalities.

### **Rockets per Israeli Civilian Fatality**

This statistic was derived by dividing the "Total Rockets Launched" by "Israeli Civilian Rocket Fatalities" to find the number of "Rockets per Israeli Civilian Fatality." See appropriate appendix category for specific citations.

### Total Opposition Fatalities

This statistic poses problems. Israel does not always recognize the accuracy of the casualty reports of the Gaza Health Ministries and certain human rights groups. While the accuracy of these data may be questionable, we have chosen to err on the side of over-counting casualties.

1. 2006 Second Lebanon War: Human Rights Watch (2007). *Why They Died*. The statistic is 1119 casualties.
2. 2008-2009 Operation Cast Lead: Van Esveld, B. (2009). *Rockets from Gaza: Harm to Civilians from Palestinian Armed Groups' Rocket Attacks*. Human Rights Watch. The statistic is 1166 casualties.
3. 2012 Operation Pillar of Defense: <http://www.bbc.com/news/world-middle-east-28439404>. The statistic is 167 casualties.
4. 2014 Operation Protective Edge: <http://www.bbc.com/news/world-middle-east-28439404>. The statistic is 2104 casualties.

### Opposition Civilian Fatalities

This statistic is problematic for the reasons noted above (see “Total Opposition Fatalities”). When counting civilian casualties, additional problems arise. Hamas members are often not in uniform during hostilities. Hamas has incentivizes to underreport the number of militants killed and to over-report the number of civilian deaths; both for internal and external purposes. Overall, it is virtually impossible to establish the number of civilians among the victims with precision. Any civilian taking a direct part in hostilities should not be considered as civilian fatality.

1. 2006 Second Lebanon War: Gross, M. L. (2008). The Second Lebanon War: the Question of Proportionality and the Prospect of Non-Lethal Warfare. *Journal of Military Ethics*, 7(1), 1-22. The statistic is 609 casualties.
2. 2008-2009 Operation Cast Lead: Van Esveld, B. (2009). *Rockets from Gaza: Harm to Civilians from Palestinian Armed Groups' Rocket Attacks*. Human Rights Watch. The statistic is 376 casualties.
3. 2012 Operation Pillar of Defense: B'Tselem. (2013) *Human Rights Violations during Operation Pillar of Defense*. The statistic is 87 casualties.
4. 2014 Operation Protective Edge: BBC (2014) *Gaza Crisis: Toll of Operations in Gaza*. <http://www.bbc.com/news/world-middle-east-28439404>. The statistic is 1283 casualties.

### **Rockets per Opposition Civilian Fatality**

In order to derive “Rockets per Opposition Civilian Fatality” we divide “Total Rockets Fired” by “Opposition Civilian Fatalities.” See appropriate appendix category for specific citations.

### **Opposition Fatalities per Day**

In order to derive “Opposition Fatalities per Day” we divide “Total Opposition Fatalities” by “Duration of Conflict (Days).” See appropriate appendix category for specific citations.

### **Opposition Civilian Fatalities per Day**

In order to derive “Opposition Civilian Fatalities per Day” we divide “Opposition Civilian Fatalities” by “Duration of Conflict (Days).” See appropriate appendix category for specific citations.

### **Total Iron Dome Interceptions**

1. 2006 Second Lebanon War: Not Applicable (Not Operational)
2. 2008-2009 Operation Cast Lead: Not Applicable (Not Operational)
3. 2012 Operation Pillar of Defense: Shapir, Y. S. (2013). Lessons from the Iron Dome. *Military and Strategic Affairs*, 5. The statistic is 421 interceptions.
4. 2014 Operation Protective Edge: Shapir, *supra* note 16. The statistic is 735 interceptions.

### **Iron Dome Interception Percentage**

We have identified a discrepancy between “Total Iron Dome Interceptions” and “Iron Dome Interception Percentage.” One can assume that to determine “Iron Dome Interception Percentage” you divide “Total Iron Dome Interceptions” by “Rockets Targeting Populace.” In the case of 2012 Operation Pillar of Defense this results in a success rate of 87.9% (nearly 4% higher than the commonly reported figure of 84%). The same problem occurs for 2014 Operation Protective Edge. The commonly reported figure is 90%, yet using our calculation we arrive at 91.3%. By following our imperfect but reasonable calculations above, we feel it is safe to assume a +/- of 5% in either direction. We have included both measures in our analysis.

1. 2006 Second Lebanon War: Not Applicable (Not Operational)
2. 2008-2009 Operation Cast Lead: Not Applicable (Not Operational)



3. 2012 Operation Pillar of Defense: Shapir, Y. S. (2013). Lessons from the Iron Dome. *Military and Strategic Affairs*, 5. The statistic is 84%.
4. 2014 Operation Protective Edge: See Gabi Siboni, *supra* note 69. The statistic is 91.3%.