

Assembling Algorithmic Warfare

The Production of Autonomous Weapons Systems in Europe and Beyond



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Abstract: Modern militaries are investing heavily in robotics and autonomous systems, sparking worldwide controversy. Scholars and activists have cited concerns over accountability and the ethical, legal and political implications of these weapons systems. There is not a large amount of literature detailing the processes surrounding technologies that currently exist. Due to the complexity and fluidity of the institutional arrangements surrounding the military robotics industry, I will apply assemblage theory to explore the way that the Milrem THeMIS, a specific technology used in the Netherlands, is produced, proliferated, and used. Assemblage theory is applied to I argue that the way in which this project is assembled from a decentralized array of actors serves to depoliticize and legitimize further development and experimentation in existing conflicts.

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I. Introduction

Since the beginning of the modern industrial era, advanced militaries have invested heavily in technology meant to automate previously human combat roles. As Paul Scharre (2019, p. 42-43) notes, Robert Jordan Gatling ushered in the era of automatic weapons during the American Civil War with the Gatling Gun, intended to fire as many rounds per minute as one hundred infantry armed with the rifles of the time. With the advent of information technology, it was inevitable that artificial intelligence would eventually be used for military purposes. The integration of robotics into military systems has been dubbed “the third revolution in warfare,” following gunpowder and nuclear weapons (Lee, 2021).

Computer scientist Kai-Fu Lee, in a 2021 editorial published in *The Atlantic*, notes the development of LAWS offers opportunities to mitigate risk to soldiers and engage in more precise targeting of enemy combatants that could save civilian lives (assuming responsible use by practitioners) (Lee, 2021). However, Lee argues that the risks and liabilities associated with LAWS far outweigh the potential advantages that they offer to responsible practitioners. The taking of human life is “a contentious act requiring justification and scrutiny” as Lee puts it. Lee is not alone in holding this opinion. Accountability for use of lethal force becomes ambiguous when the decision-making is delegated to an autonomous system. Serious military

mistakes related to use of AI have already occurred. To use one prominent example, during the 2003 US-led invasion of Iraq, a patriot missile was launched at a British jet that had been falsely identified by American computer systems as an Iraqi missile, killing two British airmen (Atherton, 2022b). Incidents such as this are considered anomalies by those in defense industries. The predominant view within military circles is that autonomous systems offer users the ability to engage in increasingly precise and rapid means of conducting war. Consequently, states will pursue development to gain competitive advantage. As Lee notes, the principle of mutually assured destruction that characterized the nuclear arms race would not apply to LAWS, as they are much more difficult to trace.

Here the reality of autonomous weapons in the modern military industrial complex is examined by looking at one example currently in use in The Netherlands: the Milrem THeMIS. Assemblage theory is applied to unpack the ways in which various Dutch and international actors with differing interests are drawn together towards the common objective of producing and proliferating this technology. Through my analysis of data on the THeMIS, I will illustrate how actors are assembled to produce an armed drone in the midst of a public controversy regarding 'killer robots.' I then explore contemporary usage of autonomous systems in warfare to situate the case in a larger context.

THEMIS (Tracked Hybrid Modular Infantry System) is an unmanned ground vehicle (UGV) developed and manufactured by Milrem Robotics in Estonia since 2015 (Atherton, 2016; BSS Holland, n.d.; Milrem, n.d.b). The drone is equipped with treads for rough terrain and is capable of traveling at speeds of up to 35 km/h. A sensor array including cameras and lidar feed into perception, motion planning, and decision-making software, as well as the remote command center. THEMIS makes use of following, patrol, return, and point to point functionalities while utilizing AI navigation and 3D map rendering to react to obstacles and environmental factors, as well to provide tactical information for increased situational awareness (Defense Procurement International, 2021). The drone's platform can be used for transport of personnel, supplies, medevac, or communications equipment. The unit is primarily designed to provide logistical and reconnaissance support to infantry units (Milrem, n.d.). THEMIS was initially conceived for the purpose of cargo transport in harsh terrain. Milrem and partners have been further developing the unit's mapping systems for surveillance purposes, and the THEMIS can also be used as a platform for aerial reconnaissance drones (Marchand, 2020). THEMIS can also be outfitted with weapons to directly engage in firefights. This places THEMIS at the center of a prominent international debate over the ethical and legal implications of arming autonomous systems, which many observers fear will lead to wide scale proliferation of unaccountable lethal

autonomous weapons systems (LAWS) or ‘killer robots’ as they are popularly known.

The idea of ‘killer robots’ has attracted considerable scrutiny from a number of advocates and organizations. A 2019 poll conducted for Human Rights Watch across 26 countries¹ found that an average of 61 percent of respondents were opposed to the use of LAWS (Deeley, 2019). This is an increase from a similar poll conducted in 2017, which found 56 percent to be in opposition. Among those opposed, 66 percent felt that the production of autonomous machines with the ability to kill was unethical, while 54 percent were concerned about accountability. In the Netherlands, 68 percent of respondents were somewhat or strongly opposed to use of LAWS, with only 12 percent in support.

Many individuals and organizations have called on states and multilateral organizations to ban LAWS. United Nations Secretary-General António Guterres, in an address to the General Assembly in September of 2018, proclaimed, “The prospect of machines with the discretion and power to take human life is morally repugnant (United Nations Secretary General, 2018).” He has called for a ban on autonomous weapons (Stop Killer Robots, 2018). The Campaign to Stop Killer Robots is a project founded in 2012 as a collaborative

¹ “The sample consists of approximately 1,000 individuals in each of Australia, Belgium, Brazil, Canada, mainland China, France, Germany, Great Britain, Italy, Japan, Spain, and the U.S., and 500 individuals in each of Argentina, Hungary, India, Israel, Mexico, the Netherlands, Norway, Peru, Poland, Russia, Saudi Arabia, South Africa, South Korea, Sweden, Switzerland, and Turkey” (Deeley, 2019)

effort between a number of NGOs, including Human Rights Watch, with the objective of advocating for bans on LAWS (Badell and Schmitt, 2021). A 2015 open letter that advocated a UN ban on LAWS gathered over a thousand signatures from AI developers and others, including high profile figures such as Elon Musk, Noam Chomsky, Steve Wozniak, and Steven Hawking (Walsh, 2015). The letter states:

If any major military power pushes ahead with AI weapon development, a global arms race is virtually inevitable, and the endpoint of this technological trajectory is obvious: autonomous weapons will become the Kalashnikovs of tomorrow. Unlike nuclear weapons, they require no costly or hard-to-obtain raw materials, so they will become ubiquitous and cheap for all significant military powers to mass-produce. It will only be a matter of time until they appear on the black market and in the hands of terrorists, dictators wishing to better control their populace, warlords wishing to perpetrate ethnic cleansing etc. Autonomous weapons are ideal for tasks such as assassinations, destabilising nations, subduing populations and selectively killing a particular ethnic group (Walsh, 2015).

In the UN, autonomous weapons systems have, since 2013, been discussed under the framework laid out by the UN Convention on Certain

Conventional Weapons (CCW), to which 125 states are parties (Bode and Huelss, 2018; Sauer, 2020; Wareham, 2020 p. 1-6; Ekelhof, 2019). Existing protocols in the CCW place restrictions on various weapons capable of causing indiscriminate harm to civilians (such as landmines and chemical weapons, for example) (Sauer, 2020; Ekelhof, 2019; United Nations, n.d.). A legally binding UN agreement on AWS would take the form of a new protocol to the CCW, however, the United States and Russia have repeatedly blocked such proposals (Sauer, 2020; Wareham, 2020, p. 5). The Campaign to Stop Killer Robots has criticized the CCW process as being inadequate in light of widespread support for binding regulation (Sauer, 2020).

According to Human Rights Watch in 2020, 97 states have issued official positions on LAWS (Wareham, 2020, p. 1-2). The majority of these statements, including those by the most major developers, emphasize maintenance of meaningful human control and compliance with existing international law. The first declaration of a policy on autonomous weapon systems came from the US Department of Defense in 2012 (Haas and Fischer, 2017) and stated the need for meaningful human control over decisions involving lethal force. As observers argue, this policy can be overridden easily and potentially contains loopholes for self-learning technologies (Haas and Fischer, 2017). Thus far, 30 countries have called for a ban on LAWS², of which only China is a developer.

² “Algeria, Argentina, Austria, Bolivia, Brazil, Chile, China, Colombia, Costa Rica, Cuba, Djibouti, Ecuador, Egypt, El Salvador, Ghana, Guatemala, Holy See, Iraq, Jordan, Mexico,

China has called for a ban on use, but not on development of LAWS (Wareham, 2020, p. 4). Heiko Maas, German Minister of Foreign Affairs, also called for a ban on LAWS in a speech to the UN General Assembly in 2018 (Maas, 2018). However, this contradicts Germany's official position, which is a commitment to multilateral cooperation in ensuring meaningful human control and compliance with international law (Bohn, 2018).

The Netherlands is an active participant in the CCW meetings on LAWS, having been a party to every meeting from 2014-2019 (Wareham, 2020, p. 37-38). The Netherlands has been in support of multilateral discussion on the legal and ethical discussions regarding autonomous weapons systems since 2013. The Dutch government states that the use of LAWS is inconsistent with existing international law, due to the lack of meaningful human control. The Netherlands has characterized meaningful human control as being composed of four elements: responsible development practices, "responsible innovation," "realistic and rigorous testing," reviews that account for the levels of autonomy in systems, and "extensive training" for military personnel on use of autonomous systems (Kayser and Beck, 2019). The Netherlands has stated that it has no plans to develop fully autonomous weapons systems (Wareham, 2020, p. 37). However, the Netherlands also rejected calls for full bans on LAWS, stating that these were unfeasible due to the fact that the

Morocco, Namibia, Nicaragua, Pakistan, Panama, Peru, State of Palestine, Uganda, Venezuela, and Zimbabwe" (Wareham, 2020, p.4)

majority of AI development takes place in the private sector (Wareham, 2020, p. 37). In 2019, the Dutch Parliament called for more legally binding regulations on LAWS (Wareham, 37-38).

Much of the Netherlands' policy is based on reports commissioned for the Dutch Parliament by two advisory councils: the Advisory Council on International Affairs (AIV), and the Advisory Committee on Public International Law (CAVV) (Autonomous Weapons Systems: The Importance of Regulation and Investment, 2022). The recommendations in the report include a ban on fully autonomous weapons through the addition of a CCW protocol. The report also however, calls upon the Netherlands to invest further in the development of semi-autonomous weapons and for standardization of these systems among NATO allies. The Dutch government has opted to invest and involve itself in talks over regulation based on meaningful human control, but has not committed to the report's suggestion for a full ban on LAWS. In order for regulation to take place, there must first be consensus.

There is not an academic or legal consensus on the definition of autonomy or meaningful human control in weapons systems, and this poses a challenge for regulation, as states may use different operating definitions. Sauer (2020) argues that regulation of LAWS under the CCW is complicated by the fact that regulators have to take the entire targeting *process* of a system's operation into account, rather than looking at features of the weapon alone as

can be done for landmines and other weapons regulated by CCW. All military technologies are necessarily subject to some level of human control in their activation or command, so a universally applicable model for regulation may not be possible, according to Sauer. In the legal debate, the most important distinction is between fully autonomous and semi-autonomous weapons.

A helpful starting point for understanding how autonomous systems function is the OODA loop, devised by US air force strategist John Boyd (Scharre, 2019, 30-32). The OODA loop is used to conceptualize autonomy by the US Department of Defense (Haas and Fischer, 2017) and is also used in the AIV-CAVV report (Autonomous Weapons Systems: The Importance of Regulation and Investment, 2022, p. 14). The loop describes the cognitive process of pilots in combat, and was developed by the US air force for reports on automation. The steps of the loop are observe, orient, decide and act, and in theory the success of military operations relies upon the speed with which the steps of the loop can be completed. The action referred to in the loop is typically firing or other application of force.

A weapon *system* is made up of the different elements used to complete the OODA loop (Horowitz, 2016; Scharre, 2018, p. 49-53). For example, as a system, a tank would consist of the communications, navigation, and optical technologies used to observe and orient, the human operator who makes decisions, and armaments used to fire at targets. A fully autonomous weapon

system would be capable of an entire OODA loop without human involvement. However most observers agree that fully autonomous weapons systems do not yet exist. In his book *Army of None*, Paul Scharre lays out three categories of autonomy based on how the OODA loop would be broken by human interaction (Scharre, 2019, 36-38). Semi-autonomous weapons have a human “in the loop” meaning that the AI is capable of identifying advisable courses of action, but requires human approval for a final action. Supervised autonomous operation has a human “on the loop”, and is capable of autonomous decision-making, but is supervised by a human who is able to intervene with the machine’s course of action. In fully autonomous systems, the human is “out of the loop” and the robot observes, orients, decides, and acts without any human supervision. An armed system with this level of autonomy would thus constitute a lethal autonomous weapon.

Though the prospect of a lethal autonomous weapon conjures up a certain image in the popular imagination associated with science fiction cliches, the technologies currently in use do not resemble these imaginaries. Scharre discusses a number of classes of weapons to illustrate the nuances of the debate around autonomy. Homing munitions have a degree of autonomy in their ability to seek targets and cannot be recalled once fired, but the decision to launch these munitions at a specific target falls to a human operator (Scharre, 2018, 48-49). In Scharre’s view, homing missiles therefore do not

qualify as autonomous weapons, as there is not a decision-making element active in their operation that would enable them to select a target, though hypothetically they could be integrated into an autonomous weapon *system*. Loitering munitions have the ability to select their own targets (more on this in chapter six), and could accurately be called lethal and autonomous, but do not necessarily constitute a system. As Horowitz (2016) argues, munitions should be clearly differentiated from systems and platforms due to the fact that the launch of a munition creates a clear line of human accountability, while an autonomous system would automate decision making. Noting the role that humans inevitably play in systems, Leese and Hoijtink (2019) argue that the project of assigning agency to technology is not a productive exercise, as these systems are ultimately tools to pursue the political objectives of their human controllers, and should always be understood in terms of their human interaction, rather than features of their design.

The label of lethal autonomous weapon does not apply to the Milrem THeMIS. THeMIS is a semi-autonomous system with a human in the loop. The drone is mostly controlled remotely by two people, and has an operational range of only 100 meters (Slijper, 2019). THeMIS is, however, being programmed with pathfinding capability that would allow it to autonomously navigate terrain in order to follow, patrol, or travel from point to point. This is done with algorithms that enable the drone to react to environmental obstacles

based on its sensor array, which includes cameras, lidar, and mapping technologies. These applications of AI would constitute the unit's ability to observe and orient autonomously.

Milrem maintains that an armed THeMIS will always have a human in the loop; according to Milrem's policy of ethical development: "Milrem believes that Meaningful Human Control should always be maintained over any robotic systems. Meaningful Human Control is our rigorous requirement to all platforms and payloads: commitment to uphold this principle is demanded from Milrem's personnel, our clients and partners. Milrem's Ethics Policy prohibits the development of any system capable of firing a weapon without Meaningful Human Control" (Milrem, n.d.a). PAX for Peace, in their 2019 report *Slippery Slope: the Arms Industry and Increasingly Autonomous Weapons* assigned ratings to developers based on a stated commitment to keeping a human in the loop to ensure meaningful human control. The ratings from best to worst in terms of commitment to ethical development are "best practice", "medium concern" and "high concern" (Slijper, 2019). Milrem Robotics was rated "best practice", being one of only four developers to earn the rating (Slijper, 2019). It is worth noting that while Milrem has clearly stated that there will always be a human in the loop in regards to firing, armaments for the unit are not manufactured by Milrem but rather by other contractors including Raytheon and Lockheed Martin, both of which were

rated “high concern” by PAX (Slijper, 2019). Other technologies developed by third parties allow THeMIS to utilize AI assisted targeting, bringing the drone into the third step of the OODA loop (MBDA, n.d.; Milrem, 2022a; Milrem, 2022b). A semi autonomous THeMIS unit capable of using lethal force is thus not a product of Milrem Robotics alone, but rather is composed of products created by various developers as is detailed in chapter five.

Much of the existing literature on autonomous systems focuses on the legal and ethical debates around potential LAWS. As Bode and Huelss (2018), as well as Amoroso and Tamburrini (2020) point out, technology is advancing rapidly, and international legal norms cannot be expected to keep pace, given the difficulties of international consensus-building. This discrepancy between technological progress and the lack of a normative regulatory framework is at the center of the academic debate. Much of the debate also concerns the notion of autonomy and the difficulties of defining it. The literature that directly addresses autonomous weapon systems is thus largely speculative, as LAWS are widely regarded to not currently exist.

There is a vast body of literature on remote warfare as a phenomenon, which is an important context for understanding the development of LAWS. As Demmers and Gould (2018) point out, there exists a “coining contest” among scholars seeking to describe the new forms of military intervention. An extensive review of all of the existing literature on the remoteness of modern

warfare is beyond the scope of this thesis. For the purposes of analysis, I will discuss Demmers and Gould's concept of liquid warfare to show how war has come to be spatially and temporally reconfigured, as well as Mary Kaldor's (2018) concept of global security cultures to give an overview of the ways in which security is viewed and practiced in an increasingly remote manner. Both of these frameworks emphasize the deterritorialization of modern warfare.

Demmer and Gould (2018) note that the race to coin new terms for remote forms of warfare is largely based on three observations. First, widespread aversion to ground wars due to the consequences of unpopular military occupations in Iraq and Afghanistan has led militaries to pursue more targeted, 'precise', and fast forms of intervention. Second, robotic technologies have been increasingly deployed in military interventions, most prominently aerial drones. Finally, war has become more networked as states engaged in counterinsurgency attempt to counter the hit and run tactics of their irregular adversaries by relying less on conventional forces. Warfare has thus become "liquid" in that it consists of rapid and often remote strikes, rather than battles as they are conventionally understood.

Mary Kaldor's (2018) framework of global security cultures, outlined in her 2018 book of that title, is meant to illustrate the ways that security is viewed and practiced in the post Cold War era. Traditionally, in line with realist perspectives, international relations scholarship has viewed the decision

making process of the state security apparatus as a matter of rational choice that can be universally understood in terms of strategic gains and losses. The realist view of security has since been challenged by many scholars from structuralist or constructivist traditions who sought to emphasize the ways in which security is embedded in larger sets of social relations or socially constructed (Kaldor, 2018, p. 17-25). Kaldor's definition of security cultures is "functional rather than spatial" and conceives of actors within a global security culture as being drawn together by shared ideas and practices rather than geography (p. 21). As Kaldor writes: " various components or elements of security cultures combine together, not necessarily harmoniously, to produce and reproduce certain types of behavior" (p. 22-23). The four global security cultures identified by Kaldor could be characterized as assemblages in their own right, but Kaldor argues that they are stable and persistent sets of norms and ideas that can be used to "categorize different forms of assemblages" (p. 33-34). The security cultures can thus be used to differentiate the rationalities by which security is assembled.

The first global security culture identified by Kaldor is geo-politics, which refers to interstate contestation and deterrence as traditionally conceived in a realist framework (Kaldor, 2018, p. 40-74). The second, new wars, is a set of trends in the post cold war era characterized by decentralized networks of state and non-state actors organized around ethnicity or religion

who control territory and resources through violence against civilians, and are often financed by criminal activity (Kaldor, 2018, p. 75- 98). The third security culture, liberal peace, involves global governance and multilateral interventions carried out by states and international organizations in the interest of promoting stability and often done under the auspices of peacekeeping or humanitarian intervention (Kaldor, 2018, p. 99-122). Kaldor's fourth security culture is the war on terror, which has seen militaries shift to fighting irregular forces by targeting individuals with increasingly high tech and remote assassination methods (Kaldor, 2018, p. 123-143).

While Kaldor argues that during the Cold War, world politics were overwhelmingly dominated by the security culture of geopolitics, processes of globalization, the declining incidence of interstate conflict, and the new focus on counterterrorism and counterinsurgency has shaped the four security cultures that exist today (Kaldor, 2018, p. 3-4). Kaldor notes that even Geo-politics has been deterritorialized to an extent, and now focuses heavily on soft power more as a more indirect means of influencing the global security architecture (Kaldor, 2018, p. 41-42). Demmers and Gould's notion of warfare as liquid is thus present in all four of the security cultures identified by Kaldor. In regards to the assemblage around the development of THeMIS and other autonomous systems on the European continent, a distinction should be made between the interstate arms race logic (corresponding with the security culture

of geopolitics) and the remote warfare logic applied to existing warzones in which states combat carry out operations against networks of irregular fighters (this corresponds with other three security cultures identified by Kaldor, but mainly new wars and the war on terror). Both the new arms race and the increasing demand for precise and remote military systems are significant drivers of development and ways of shaping the global security environment. The increasingly liquid character that warfare has taken on is rendered by developers and military practitioners as a problem solvable through technological innovation, and demand for innovation inevitably increases as states compete to maintain their technological edge.

Marijn Hoijtink (2022) points out another trend in modern warfare, dubbed “prototype warfare”. Modern conflicts are increasingly being used by militaries and contractors as a means of experimenting with new technologies and methods. Hoijtink argues that experimental rationality is increasingly used to legitimize military interventions, as any data gathered could be characterized as a success, regardless of progress towards military objectives. Failures can be written off as valuable learning opportunities. This trend is occurring because the current pace of technological development renders mass production of new technologies unfeasible. Prototypes are instead deployed for experimentation through use in active conflicts. Hoijtink argues that experimental rationality has come to guide military activity outside of active

conflict as well. For example, the Dutch army used the COVID-19 pandemic as an opportunity to open a data center that was experimenting with machine learning to analyze large amounts of data on Dutch protest movements. The data center was meant to analyze trends in COVID misinformation, but ended up collecting data on unrelated movements such as the Black Lives Matter protests in the Netherlands.

There are a number of key takeaways from the existing literature on the development of autonomous weapon systems. While there is a clear demand for regulation, and the CCW in theory provides a means of establishing said regulation, the emergence of a legally binding framework is hindered by a lack of consensus both on the definition of autonomy and what form regulations should take. The technology is advancing more rapidly than the institutions capable of constraining it are able to act. The demand for robotic military technologies can be explained largely by the switch to more remote means of waging war, as warfare now revolves around ‘shaping’ the security environment rather than direct territorial control, as Demmers and Gould, as well as Mary Kaldor, point out.

There is not a substantial body of literature focused on the existing reality of autonomous weapon systems and how these projects are assembled by states and developers. While there is not an existing ‘killer robot’ with a trail of destruction to study, the fact remains that there is currently research,

development, proliferation, and use of various weapons systems that incorporate some level of AI. These are large projects involving many different institutions and large amounts of money. Little appears to have been written about the ways in which these efforts are put together.

Maaïke Verbruggen (2019) has written on the topic of civilian innovation in the development of AWS in the United States, noting how little data and research exists on the topic. Verbruggen points out that while the role of the private sector in the defence industry is often used as an argument against the efficacy of regulation (such as by the Netherlands, for example), there are in fact a number of obstacles to civilian companies taking the lead on the development of autonomous weapons systems. The research and development process in the private sector is quite different from that of the traditional military industrial complex and thus private companies cannot always reliably deliver products suitable for military use. Military technology is only moderately profitable, and large amounts of bureaucratic red tape make it difficult for contractors to enter the industry, at least in the case of the United States. In addition, technologies from the private sector that are adopted need to be modified for military use by technicians with specialized knowledge that can only exist within the military.

While the aforementioned article discusses the political economy of producing autonomous weapon systems, it still does so within the context of

policy and regulation. While policy and regulation are unavoidable and obviously important facets of this topic, there is a deficit of literature discussing technologies that currently exist and how these technologies are brought into existence by involved actors. In this research, I hope to shed light on the process of research, development, and proliferation by looking at an existing technology in detail. I hope to look primarily at how this project is assembled and approach policy through its relevance to the assemblage

II. Methods

I have formulated the following research puzzle:

How have security assemblages pursued the development and proliferation of autonomous weapons systems in the Netherlands from 2015³ to 2022?

In order to unpack this puzzle, I will be answering the following four sub-questions: 1. *What actors and institutions are involved in the production and distribution of autonomous weapons systems?* 2. *How do involved actors contribute and/or benefit?* 3. *What discourses work to legitimize the development of autonomous weapons systems?* 4. *How are the technologies currently being used?*

The method employed here is document analysis. I gathered a large pool of publicly available documents (n=97) in order to analyze the production and proliferation of the THeMIS. The documents include advisory reports, press releases, news articles and speeches. The documents come from a variety of institutions, such as Milrem Robotics, The Dutch Ministry of Defence, NATO, the UN, the EU commission, The Red Cross, The Campaign to Stop Killer Robots, PAX for Peace, and more. The idea was to gather a large amount of data on THeMIS, as well as related technologies and events, from involved parties in a relatively short amount of time in order to examine how the project is assembled and what discourses surround it. As was explained in chapter I, the existing body of academic literature on the topic mostly revolves around

³ 2015 is the year that THeMIS was unveiled.

the policy debates surrounding LAWS. My goal is to look at the empirically observable realities of development and proliferation first and foremost. For this reason I will be primarily relying on documents from relevant institutions over academic literature.

It should be noted that most of the documents used are issued with public relations in mind by the institutions involved. The dataset therefore has an institutional bias. Much of the data reports relatively uncontroversial facts or events, and these sorts of claims are taken more or less at face value. Narrative is also important to understanding the big picture, and attention will be paid to legitimizing discourses in chapter VI. Information that is omitted from official statements is also noteworthy, for reasons that are explained in chapter VI.

In Chapter IV, I will analyze documents that legitimize production and eventually use of RAS by the ways in which actors present problems as solvable through their technical expertise (answering sub questions 2 and 3). Chapter V will examine the networks of actors that have been assembled to contribute to the development and proliferation of THeMIS in Europe, mostly through official statements announcing partnerships and transactions (answering sub question 1). Chapter VI will attempt to explain how the assemblage interfaces with the demand for public accountability (answering sub question 3). Finally,

Chapter VII will outline examples of the use of RAS in contemporary conflicts
(answering sub question 4).

III. Assemblage Theory

To conceptualize the complex and decentralized array of actors, institutions, and discourses involved in the production, proliferation, and legitimation of THeMIS and other robotic military technologies, assemblage theory will be used. Assemblage Theory is an approach to social organization with origins in the philosophy of Gilles Deleuze and Felix Guattari (Deleuze and Guattari, 2017). As Nail (2017), puts it, the general logic of assemblage as put forth by Deleuze and Guattari in *Thousand Plateaus* and other works emphasizes “the rejection of unity in favor of multiplicity and the rejection of essence in favor of events”. The central assumption of assemblage theory is that the social world, particularly in modernity, is highly fluid and consists of various heterogeneous elements that are brought together or *assembled* to work towards common objectives. Assemblages can then be disassembled and reconfigured over time in response to changing environments. Assemblage theory is at its core, a rejection of essentialism. Essentialist views of social reality result from the grouping together of different elements by shared ontological properties into a relatively static whole, while assemblage theory emphasizes the difference of the assemblage’s different components and the ways they combine, disassemble and recombine over time. The relationship between components of assemblages are thus defined by their *exteriority*, as opposed to the *interiority* of relationships based on shared ontological

properties (Delanda, 2016; Nail; 2017; Savage, 2019). The heterogeneous components of an assemblage consist of actors, institutions, and discourses that contribute to the functioning of the social process in question. Since Deleuze and Guattari operated in the realm of pure philosophy, some scholars, such as Delanda (2016) claim that they did not develop a consistent and concrete framework (though Nail disputes this). Consequently, a number of scholars have adapted the assemblage approach to be more suitable for application in the social sciences.

Tania Murray Li, in her 2007 article *Practices of Assemblage and Community Forest Management*, posits that assemblages can be concretely discussed in terms of practices, and incorporates the Foucauldian concept of governmentality in order to identify six practices that characterize policy assemblages in her analysis of forest management practices in Indonesia. *Forging Alignments* is the process by which the interests of involved actors are linked together to enable collaboration. *Rendering Technical* refers to the conceptualization of a social problem as solvable through intervention by experts with the necessary technical expertise. *Authorizing Knowledge* is the practice of identifying the bodies of knowledge needed to address the problem. *Managing Failures and Contradictions* is relatively self explanatory, referring to the ways in which any failures of the assemblage are managed through compromise and framed as rectifiable errors, rather than the result of internal

contradiction within the assemblage. *Anti-politics* is the depoliticization of an issue by framing it as a matter of technical expertise rather than policy.

Reassembling is the continual process of reconfiguration of the assemblage, incorporating new elements and modifying discourses accordingly.

The assemblage associated with the development and proliferation of autonomous weapons in Europe is an example of what Abrahamson and Williams (2009) term a *global security assemblage*, defined as “settings where a range of different global and local, public and private security agents and normativities interact, cooperate and compete to produce new institutions, practices, and forms of security governance”. Typically, international relations scholarship looks at states as the primary unit of analysis and all other institutional dynamics are seen as secondary. Assemblage theory will be utilized here for its capacity to conceptualize military industrial complexes in a way that does not center the state as a monolithic and static entity. There are multiple layers of actors, institutions, and discourses involved in the development and proliferation of autonomous weapons, including states, transnational organizations, and developers in the private sector. In addition, states themselves are made of various networks of actors with their own interests and autonomy, and a view of a state as an ontological unity would not sufficiently account for these internal dynamics. Within any institution, there may be actors with contradictory attitudes or interests. As Li (2007) points out,

the management of these contradictions by involved actors is key to the successful operation of the assemblage. In line with the analysis of Abrahamson and Williams, the global security assemblage is deterritorialized (to use Deleuze and Guatarri's terminology), and consists of a multiplicity of both globalized and localized institutions and practices.

Demmers and Gould (2018) apply Li's assemblage framework in their analysis of AFRICOM operations against the Lord's Resistance Army in Uganda. According to the authors, this framework was selected for its capacity to explain the fluidity and deterritorialized nature of the phenomenon that the authors dub 'liquid warfare'. This term refers to a recent transformation in the ways that states approach security, in which states seek to influence the global security environment through increasingly indirect means such as soft power, remote technologies, targeted killings, and reliance on cooperation with networks of local actors and private contractors. This contrasts with the more traditional approaches to security policy, which centered around direct control of territory by states and their proxies, as well as relatively stable alliances. Mary Kaldor (2018, p. 42) similarly invokes Michel Foucault's concept of biopower to describe the modern security cultures, stating: "it is about control of population rather than territory, or rather it is about the control of territory through populations". Consequently, military industrial complexes which previously centered states have been reassembled around this new paradigm.

As will be shown in the following sections, there is a large constellation of different discourses and actors involved in the development, production, and proliferation of the THeMIS.

IV. Rendering Technical

For militaries that adopt autonomous systems, there are many problems in the global security environment that can be presented as solvable through investment in RAS. These issues can be categorized as either large-scale strategic issues of national security or tactical issues involving various obstacles to efficiency on the battlefield. This distinction has become blurry, as technologically advanced militaries increasingly pursue more liquid or networked forms of warfare in which the increasingly remote tactics employed mean that much of the time there may not even be a 'battlefield' as traditionally conceived. As Demmers and Gould (2018) note, war has gone 'mobile' and states avoid conventional battles through remote technologies, targeted operations, and localized partnerships. Nonetheless, THeMIS is an example of a remote technology that assumes a more traditional battlefield role, as it is intended to support infantry units. As one of the earliest releases on robotics from the US department of Defense puts it, combat roles that are worth automating are those that are "dirty, dull, or dangerous" (United States Department of Defense, 2007).

On the purely tactical level, THeMIS is primarily adopted for a number of logistical purposes, such as cargo transport, medevac, and bomb defusal, automating roles that previously would have been performed by humans. Much of the tactical benefit provided by autonomous systems, according to

practitioners, is improved interoperability, which also figures into the larger strategic objectives of states. Interoperability is defined as “the ability of systems, units, or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together” (Pernin and RAND corporation, 2019).

Common adoption of, or at least familiarity with a given technology contributes to interoperability among allies. This is why NATO and the EU claim that they are involved in procurement. Estonian Maj. Gen. Andis Dilāns, in a book on unmanned ground vehicles put together by Milrem, characterizes a lack of interoperability as the one of the greatest security challenges for the European Union, noting that members have largely focused on developing their own national defence industries without consideration of the larger security architecture (Romanovs and Andžāns, 2019). Another author featured in the book, Kristina Prišmantaitė writes: “By investing in defence research, innovation, and technologies, the EU will enable the deepening of defence cooperation, enhancement of interoperability and efficiency, the development of capabilities and advanced technologies needed for a full spectrum of armed forces” (Romanovs and Andžāns, 2019). NATO’s Cooperative Cyber Defense Center of Excellence report, published in 2021, similarly characterizes fragmented innovation as problem to be overcome by by improving interoperability within the alliance, writing: “ A widening capability gap in

AI-enabled technologies may result in some member states being relatively less equipped to respond to a faster conflict environment in which adversaries rely on AI-enabled and/or increasingly autonomous systems” (Gray and Ertan, 2021). The logic of interoperability thus directly causes proliferation within military blocs in this way.

The Dutch Ministry of Defence, in its 2020 report titled *Defence Vision 2035*, identifies a number of perceived threats to strategic stability (Ministerie van Defensie, 2020). These include fallout from an escalating trade war between the US and China, modernization of militaries of potential adversaries (mainly Russia and China), increasing cyber attacks, proliferation of advanced weapons systems among NATO rivals, and the growth of international terrorist networks being exacerbated by growing political frustration, inequality, and ecological catastrophe. Hybrid conflicts involving information warfare are characterized as “the new normal”. Many of the MvD’s concerns revolve around challenges to NATO. As the report says “ A politically and militarily strong NATO is our main guarantee of security” and Brexit and lack of US commitment are identified as problematic fissures within the NATO bloc that threaten the European security architecture. The MvD also identifies a lack of manpower and funding and issues in adapting to new realities of information warfare.

One of the MvD's objectives for the year 2035 is units that are "rapidly deployable, scalable, and self-supporting" and calls for more mobile units with shorter reaction times that are interoperable with allies but also capable of effective independent functioning (Ministerie van Defensie, 2020). The ministry states: "Emerging and disruptive technologies present risks as well as opportunities" and consequently encourages investment in these new technologies through networks of civil society partnerships. While re-stating its commitment to multilateralism in the European security environment, the MvD also claims: "we will also have to learn to navigate a world where unilateralism and protectionism, bilateral agreements and ad hoc coalitions play a greater role". Much of the MvD's impetus for adoption of new technologies thus lies in a desire to maintain the edge held by NATO and the EU, while also being prepared to adapt to the realities of a more multipolar world system in the event of a crisis in these blocs. Another 2018 memo on defence industry strategy stresses the importance of developing an independent base of technological expertise and production capacity for the country (Ministerie van Defensie, 2018). The stated objective is "to procure the best product for the best price, with the greatest level of involvement of the Dutch business community". The memo goes on to state that while the MvD may procure non-Dutch technology where it would be more feasible in terms of value, a "stable base of knowledge, technology, and industrial capabilities"

is key to both “credible international collaboration” and the country’s ability to independently protect national security interests.

Production of autonomous defence systems such as THeMIS is legitimized by discourses that envision a fundamental transformation in the ways that wars are waged. The case for expansion of RAS in modern militaries is made in an op-ed for the Council on Foreign Relations titled *Stop the “Stop the Killer Robot” Debate: Why we need Artificial Intelligence on Future Battlefields*, by law professor Hitoshi Nasu and Colonel Christopher Korpela, director of the Robotics program at West Point (Nasu and Korpela, 2022). In line with the positions of the Dutch Ministry of Defence and the US Department of Defense, the authors argue that existing international law is sufficient to ensure ethical practices in military AI. The authors also argue that a ban would put law-abiding states at a disadvantage against “rogue nations and malicious actors”. The concerns about accountability are rendered technical, as Nasu and Korpela opine that risks with predictability and reliability can be addressed with further technological development. Nasu and Korpela go a step further, arguing that AI offers humanitarian benefits due to improved precision, and can be used to mitigate the risk of human error. Arguments such as these are common due to the liquid nature of modern warfare, and the security cultures that emphasize remoteness and targeted strikes.

V. Actors and Alliances

Milrem Robotics is an Estonian company founded in 2013 which specializes in the development of all-terrain robotic ground vehicles (Milrem, n.d.). While best known for THeMIS and its other military drones, Milrem also produces lines of drones for various civilian applications including forestry, rescue, firefighting, mining and agriculture. Though a private company, Milrem receives public funding through public-private partnership projects with Enterprise Estonia and the European Union's European Regional Development Fund. The Netherlands initially acquired two THeMIS units in 2019 (Milrem, 2019) and has since acquired six of the drones (Thornton, 2020; Milrem, 2021f). The partnership between Milrem and the Dutch Armed Forces prompted Milrem to open its Central European Robotics Center in Best, chosen for its proximity to the Eindhoven technology region (Milrem, 2021f). Milrem also maintains offices in Sweden and Finland (these states also contract with Milrem).

As was noted earlier, Milrem collaborates with an array with other contractors who develop software, armaments, and attachments for the THeMIS. As Milrem has publicly committed to refrain from producing their own armaments for THeMIS, this is outsourced to a number of American and European weapons manufacturers including Raytheon, Lockheed Martin, MBDA, FN Herstal, KONGSBERG, Hornet, and EOS (Slijper, 2019; Milrem,

2022). Live fire exercises involving THeMIS or other Milrem drones are often collaborative efforts between multiple military users and weapons manufacturers. For example, in a 2019 test conducted in Alabama, Lockheed Martin, Raytheon, and the US Army collaborated to fire javelin missiles from a KONGSBERG rocket launcher mounted atop a Milrem/ Qinetiq Titan (Lockheed Martin, 2019). The Titan is a modified THeMIS model using software developed by Qinetiq, a British defense contractor (Romanovs and Andžāns, 2019, Qinetiq, n.d.).

In the Netherlands, THeMIS is being tested by Royal Dutch Army's 13th Light Brigade, which has a Robotics and Autonomous Systems unit stationed in Oirschot. (Thornton, 2020). Under the terms of the contract negotiated between the Dutch Ministry of Defence and the Estonian Center for Defence Investment (The procurement agency of the Estonian Ministry of Defense), Milrem is responsible for integrating third party hardware and software, which is done via the company's Intelligent Functions Kit. The Milrem Intelligent Functions Kit (MIFIK) is the company's basic software set for enabling autonomous functionalities in THeMIS and other vehicles, and is the platform by which all third party software and hardware modifications are integrated (MilitaryLeak, 2020; Thornton, 2020).

THeMIS is also being outfitted with software and hardware that enables it to be used in conjunction with other drones. Project SPEAR is a swarming

technology using aerial drones developed by Tective Robotics, Delft Dynamics, TNO, and Avalor AI (Vision + Robotics, 2020; De Jager, 2021). Algorithms written by Avalor AI and TNO allow a single user to launch a number of small aerial drones that autonomously fly in a coordinated pattern to survey the battlefield (Vision + Robotics, 2020, De Jager, 2021). Machine learning algorithms allow the drones to identify targets (De Jager, 2021). Tective Robotics, a startup founded by students from TU Delft, won a contract with the Ministry of Defence via a MvD sponsored Defense innovation competition for developing the Skyhive, a charging and launch platform for swarming UAV's, which can be mounted on the THeMIS (Marchand, 2020; Vision + Robotics, 2020; De Jager, 2021). The 13th Light Brigade is currently testing THeMIS as a mobile platform for aerial drone swarms using the SPEAR algorithms (Marchand, 2020; Vision +Robotics, 2020).

In addition to the Netherlands and Estonia, THeMIS is used by Belgium, Norway, Germany, Australia, the United Kingdom, the United States, France, Finland, Australia, Latvia, and Thailand (Army Technology, 2021; Milrem, 2022, Milrem, n.d.ba). Milrem secures contracts with assistance from a number of institutions. In January of 2022, NATO's Support and Procurement Agency awarded Milrem a five year contract with the Italian Army to enhance the capabilities of its robotics and autonomous systems units (Defence Procurement International, 2022; NATO Support and Procurement Agency,

2022; Ruzhelnyk, 2022a). The contract followed a 2020 demonstration of the autonomous capabilities of THeMIS with MIFIK in Italy, and is part of a program launched by Milrem called Intelligent Systems Implementation Analysis and Assessment meant to evaluate capabilities of armed forces and create a roadmap for improvement (Milrem 2020a). According to Milrem: “[Intelligent Systems Implementation Analysis and Assessment] is comprised of three steps: analysing the requirements of the armed forces, implementing the tailor-made RAS solution with the integration of provided and/or customized technologies for the armed forces by the local industry, and evaluating the outcome.” In this way, Milrem has taken on an advisory role to armed forces seeking to invest in robotics and autonomous systems.

NATO maintains a research organization called the NATO Cooperative Cyber Defence Centre of Excellence (CCDCOE), based in Tallinn (home of Milrem) (Gray and Ertan, 2021). The Centre aims to serve as a resource for contributing countries to develop and implement AI strategies. The CCDCOE report titled *Artificial Intelligence and Autonomy in the Military: An Overview of NATO Member States’ Strategies and Deployment* states that NATO has no legally binding authority to shape national AI policies. NATO is, however, in a position to facilitate dialogue between member states to encourage collaboration, and CCDCOE is the body of expertise authorized to do this. The report characterizes CCDCOE as being made up of “experts from military, government, academia,

and industry, currently representing 35 sponsoring and contributing nations' '. CCDCOE encourages the standardization of systems across the alliance as means of addressing interoperability issues, as Gray and Ertan write in their report: "NATO must work to integrate AI into military systems in an interoperable way and stresses the importance of cooperation between NATO, the private sector, and academia in developing AI for defence purposes"'.

The European Union is also involved in funding research and development, and in 2018 the EU parliament decided that €500 million that was allocated to defence could be potentially awarded to RAS developers, despite complaints from some in the EU parliament (Atherton, 2018b; Teffer, 2018). The European Commission's European Defense Industrial Development Program (EDIDP) has also assembled a consortium aimed at the proliferation of autonomous defense systems, coordinated by Milrem (European Commission, 2020) The project is titled Integrated Modular Unmanned Ground System (iMUGS) and has a budget of approximately €32,595,365. 30 million of which is contributed by the EU. In addition to Milrem, the consortium consists of eleven other defence companies from Estonia, France, Finland, Spain, Germany, Latvia, and Belgium, as well as the military academies of Estonia and Belgium, who collectively provide 2 million of the project's budget. The iMUGS project aims to assemble the expertise to "develop a modular and scalable architecture for hybrid manned-unmanned

systems”, that is, to ease collaboration between EU states in integrating robotics and autonomous systems into their armed forces through the common adoption of a number of systems designed for interoperability. A 2021 demonstration in Latvia using the THeMIS as well as a number of other technologies from iMUGS contributors aimed to exhibit the benefits of the combined iMUGS systems (Milrem, 2021e).

An armed and semi-autonomous THeMIS unit is created from a highly decentralized web of expertise, subject to constant reconfiguration. Milrem is responsible only for the production of the body of the drone, as well as the MIFIK software that allows basic autonomous functionalities and compatibility with additional hardware and software. Weapons and software, the elements that could potentially turn the unit into a ‘killer robot’ are outsourced to third parties. Militaries that procure the drone are responsible for attaining these additional components separately. This is not a mistake.

VI. Managing Failures and Contradictions

Overall, the assemblage in question works smoothly, and the different stakeholders do not seem to be at odds with one another. Perhaps the largest challenge for the actors in the assemblage is maintaining positive public relations in the midst of the ‘killer robots’ discourse. The evidence suggests that the decentralized nature of the assemblage itself renders actors publicly accountable for their own smaller pieces of the larger project. This is advantageous for each organization involved, as none are obligated to answer for building an armed robot in the public sphere. This may be why, for instance, the Dutch government has argued against LAWS bans on the grounds that development occurs primarily in the private sector (Wareham, 2020, p. 37), while also relying heavily on the private sector for its own RAS development. This is not to suggest the existence of a shadowy conspiracy to build LAWS behind closed doors. Rather, actors are acutely aware of the public anxiety around imagined killer robots, so they rely on a decentralized body of expertise to pursue research, development, and proliferation of RAS.

This is in line with Michel Foucault’s notion of governmentality (Foucault, 2009; Gutting and Oksala, 2003), in which behavior is managed not through direct exercise of compulsory power, but rather through productive power in which actors fill roles defined through the knowledge and capabilities that they provide (Barnett and Duvall, 2005). As Abrahamson and Williams

(2019) argue, security governance has continually been reassembled according to a horizontally integrated and networked logic that has come to characterize institutional arrangements in the neoliberal era. By broadly distributing responsibility for development of THeMIS and related technologies, the assembled global and local actors are able to assume responsibility for smaller pieces of the project in ways that maintain the productive power of the assemblage while managing potential critiques from the public through the decentralization of expertise. The limited role that each actor plays within the assemblage then contributes to the smooth functioning of the assemblage at large. This can be seen in Milrem's stated commitment to maintaining meaningful human control, while also not being responsible for arming the unit. The companies that produce the armaments also cannot be held accountable for what happens with their products, as responsible use is ultimately up to the states that procure it. Of course, the Netherlands has cited the role of the private sector to argue against a LAWS ban under CCW.

Notably absent from any of the documents from Milrem, the MvD and other parties is any detailed explanation of the levels of autonomy. Though it is easy to locate footage of live-fire demonstrations involving THeMIS, available documents do not explain how an armed THeMIS aims and fires at targets in any detail. Directly addressing levels of autonomy and how they relate to use of lethal force would bring the drone into the contentious political debate

surrounding LAWS. The actors have a vested interest in depoliticizing development and presenting it as a solution to a number of issues manageable through their expertise.

As Maaïke Vergruggen (2019) argues, the “creeping” pace of private sector development means that there will likely not be a watershed moment in which unambiguously lethal and autonomous weapons appear. States are likely to continuously test new prototypes in battlefields that are far from the public eye (Hoijtink, 2022) while stating their commitment to existing bodies of international law and norms, as well as the need for meaningful human control. Research, development, and proliferation are thus able to be conducted in a manner that skirts large amounts of controversy by decentralizing these processes and distributing responsibility broadly among various societal actors, while ensuring that all actors appear ethical and accountable. The controversy is acknowledged, but actors appear to be cautious about divulging potentially contentious information about their products.

VII. Existing Use of RAS in Warfare

In 2020, an Estonian infantry platoon deployed to Mali as part of Operation Barkhane, the French-led campaign against Islamist insurgents in the Sahel region (THEMIS Deployment in Mali, 2020). Accompanying the unit was a single Milrem THEMIS. According to Milrem's report, the drone was used primarily for transport of cargo, as its all terrain treads were well suited to the rough desert terrain. The THEMIS notably assisted the platoon's armed personnel carriers, which had terrain-related issues. The drone was also used as a platform for a tethered aerial drone, which was used for surveillance. The Estonian platoon did see combat in an attack involving small arms fire and an improvised explosive device that resulted in injuries to six coalition soldiers and the deaths of three insurgents. The THEMIS was around 10 meters from the explosion, and Milrem notes that the unit's armor successfully protected all critical components from the force of the blast.

This is the only time that THEMIS has been deployed in an active conflict. Milrem states that the operation proves the drone's ability to function in arid desert conditions and that the opportunity was used to collect large amounts of data (Milrem, 2020c). The documents from Milrem make no mention of whether the Estonian platoon was able to accomplish strategic objectives in the counterinsurgency campaign. They discuss only the performance of the THEMIS. It would appear that the Sahel conflict was thus being used as a

testing ground by Estonia and Milrem, in line with the experimental rationality of prototype warfare, as described by Hoijtink (2022).

As was mentioned by the Dutch MvD and others, the geopolitical arms race results in large part from China and Russia's investment in RAS. There is currently no evidence of technology that would widely be considered LAWS being developed and used by the People's Republic of China (Kania, 2021). However, since 2016, China has granted more patents in military AI than any country on earth (Kayser, 2021). The Chinese defence industry has invested in AI guided missiles, and is currently experimenting with remote control and some levels of autonomous functioning for land, air, and sea vehicles (Kania, 2021). Dan Kayser of PAX notes that the Chinese technology sector has developed AI technologies for the purposes of surveillance and data gathering, and that this technology could be central to China's future development of military RAS (Chan, 2019). The US Department of Defense claimed in 2019 that China has sold drones advertised as possessing full autonomy, but this claim does not appear to have been substantiated (Kania, 2021). China has, however, been reported to be selling drones that incorporate some levels of AI to Saudi Arabia and Pakistan (Slijper, Kayser, and Beck, 2019).

Russian RAS development is far more centralized and state-driven than the more privatized assemblages found in Western Europe. Since 2012, Russian research and development has been directed by a government agency called

the Advanced Research Foundation (ARF) (Slijper, Kayser, and Beck, 2019; Nadibaidze, 2022). This is likely because the Russian regime's lack of expected public accountability does not force it to outsource development for optical purposes. There has been a push to encourage civil-military cooperation in AI development, and the Russian Ministry of Defence has multiple initiatives to involve universities in research and development. This includes the construction of a "technopolis" known as Era, which acts as an R&D center for recent university graduates and other experts working in the field of robotics (Slijper, Kayser and Beck, 2019; Naidbaize, 2022).

Russia currently produces a number of UAVs and UGVs that incorporate AI. One noteworthy Russian UGV is the Rostec URAN-9, a treaded unmanned vehicle which, unlike THeMIS, qualifies as a true tank designed for combat. A remote controlled URAN-9 was reportedly tested in Syria in 2018 (Atherton, 2018c; Roblin, 2021) and it was found to have a number of operational issues (most notably a short range for effective remote control) that Rostec has since been working to resolve based upon the data gathered. In 2014, the Russian Federation set a goal of robotizing 30% of combat roles by 2035, and Defense Minister Sergei Shoigu in 2021 claimed that Russia had started already producing autonomous weapons (Nadibaidze 2022). In 2019, Russian developer Sukhoi was reported to be developing a semi autonomous aerial combat drone known as *Okhotnik*, or hunter, which would be capable of

autonomously launching, navigating, and landing, but requires human approval for use of its weapons (Slijper, Kayser, and Beck, 2019). At the UN, Russia has stated that LAWS do not yet exist, and acknowledged the widely agreed upon importance of meaningful human control (Slijper, Kayser, and Beck, 2019; Nadibaidze, 2022). Overall, US intelligence considers Russian RAS capabilities to lag behind that of the US and China (Kahn, 2022).

Another major developer of military robotics is South Korea, which is also a leader in robotics development for civilian markets, and has the highest robot to human ratio in the world (Haner and Garcia, 2019; Slijper, Kayser, and Beck, 2019). The SGR-A1, produced by Hanwha Aerospace (formerly a subsidiary of Samsung) is a stationary robotic turret equipped with a machine gun and a grenade launcher. SGR-A1 can be remote controlled, but is also capable of using infrared sensors to detect and fire upon enemy combatants. In this setting the turret is autonomous in its ability to select targets, but has a human-on-the-loop and can be deactivated upon command. Operational SGR-A1 units are used in the Korean demilitarized zone and were also deployed at South Korean bases in Iraq and Afghanistan. A similar turret called the Super aEgis II is also used in the demilitarized zone, though this unit requires human approval in order to fire, as the manufacturer (DoDAAM Systems) was pressured to install safeguards. The South Korean government has set up programs to promote civilian-military cooperation in robotics development,

and has created a military unit specifically devoted to integration of autonomous systems.

One class of weapon currently in use that arguably toes the line of full autonomy are loitering munitions, also known as “kamikaze drones” or “suicide drones”. Once activated, these weapons hover in an area and search for potential targets. Once a target has been identified, the munition strikes the target and explodes (Horowitz, 2016; Scharre, 2019 p. 54-57). Paul Scharre claims that an American loitering munition, the Tomahawk Anti-Ship Missile, produced in the 1980’s, bore the distinction of being the first fully autonomous weapon, though it never saw use (Scharre, 2019, p. 57). Many loitering munitions are semi-autonomous, requiring human approval before striking (Scharre, 2019, p. 54-57). Others, such as the Harpy, produced by Israel, select targets and strike without a human in the loop. The Harpy is capable of loitering for two and a half hours, and selects targets based on enemy radar (Scharre, 2019, p. 54-55). The Harpy has been sold to “Chile, China, India, South Korea, and Turkey” among other countries (Scharre, 2019, p. 54) and existing variants include the mini-harpy and the Harop (Slijper, Kayser and Beck, 2019).

In 2016, Israeli loitering munitions were deployed by Azerbaijan in border clashes with Armenia, including the Harop (Gibbons-Neff, 2016). Armenian air defense systems, artillery, as well as at least one bus of

volunteers were destroyed (Gibbons-Neff, 2016, Newdick, 2021). These strikes may have constituted the first deaths by lethal autonomous weapons. The 2020 Nagorno-Karabakh war between Azerbaijan and Armenia saw the use of loitering munitions by both sides (Atherton, 2021). Azerbaijan's use of the Harpy and Harop was widely noted to be effective, and Armenia lost large numbers of tanks, artillery, and air defense systems to the loitering munitions (Shaikh and Rumbaugh, 2020; Newdick, 2021). Despite the attention paid to AWS in Europe and North America, the Nagorno-Karabakh war was not widely reported on in English-language media, and detailed information was difficult to come by.

A 2021 report by the UN claims that a Turkish loitering munition was used in Libya in 2020 (Cramer, 2021; Hernandez, 2021). The munition in question is the Kargu-2, produced by STM. The report explicitly describes the unit as a lethal autonomous weapons system and indicates that it was used by the Libyan government against fleeing enemy militia. The report does not state whether usage of the drone resulted in any deaths, and it is not clear if targets were selected autonomously or whether the drone was operated remotely. Nonetheless, the report attracted more attention than the confirmed use of loitering munitions in the Nagorno-Karabakh war ever received.

The 2022 Russian invasion of Ukraine has brought much attention to the use of RAS. Notably, Ukraine's use of the Turkish-made Baykar TB2, better

known simply as the Bayraktar, has attracted international attention⁴. The UAV is relatively inexpensive and is equipped with a number of autonomous functionalities, including landing, take-off and navigation, but requires human approval for use of its weapons, so can be considered semi-autonomous (Bagirova, 2022; Khan, 2022; Witt, 2022). Ukraine purchased the drones in 2019, and they have since become a symbol of Ukrainian resistance, due to the large losses they inflicted upon Russian forces in the early phases of the invasion (Bagirova, 2022; Witt, 2022). Bayraktar was even the subject of a popular Ukrainian patriotic song (Bagirova, 2022). The drone has since been in high demand, and users come to rely on the Turkish developers for exclusive access to training, maintenance, and components (Witt, 2022). This has given Turkey considerable leverage in the international drone market. Baykar is currently developing a TB3 model (Bagirova, 2022).

Russia, meanwhile, has reportedly deployed loitering munitions such the KUB-BLA and the Lancet, both manufactured by legendary weapons developer Kalashnikov (Kahn, 2022; Kallenborn, 2022; Kayser, 2021; Allen 2022). Images surfaced on Twitter of what appears to be a KUB-BLA crashed on a Kyiv street (Kallenborn, 2022). While Kalashnikov has stated that their munitions were used in Ukraine, Gregory Allen (2022), writing for the Center for Strategic and International Studies, argues that the evidence suggests that AI was used to

⁴ The Bayraktar was also used by Azerbaijan in the Nagorno-Karabakh conflict, by Turkey against the Islamic State and the Kurdistan Workers Party (PKK), as well as in Syria and Libya (Witt, 2022)

guide the munition, but not to select targets. The Lancet is marketed as Russia's answer to the Harpy, and has been tested with remote control in Syria (Allen, 2022). In July of 2022, images of a crashed Lancet munition in Ukraine were posted to Twitter (Southfront, 2022). It is not yet clear whether the munitions were being controlled remotely or autonomously.

Loitering munitions have also been deployed on the Ukrainian side. The United States has provided 100 Switchblade loitering munitions to Ukraine (Dilanian, De Luce and Kube, 2022; Atherton, 2022a). The Switchblade is able to find and track targets autonomously, but are directed by a path pre-programmed by a human. The drone can also be manually recalled (Atherton, 2022a). The Switchblade thus has a human on the loop, and is semi-autonomous.

The pattern that becomes clear when looking at deployment of RAS in actual conflict is that the experimental rationality of prototype warfare incentivizes countries that develop autonomous systems, such as Estonia, Turkey, the US, and Russia, to use conflicts as testing grounds to gather data and improve upon their technology. The conflicts in which these countries experiment are typically 'New Wars' as Mary Kaldor (2018) would describe them. That is, they involve irregular or 'criminal' forces that can be described as terrorists or insurgents, and they do not attract large amounts of press. Testing weapons in wars against state combatants protected by international

humanitarian law would likely attract more controversy. These sorts of interventions are often carried out under the pretense of stabilization, as is common in the security culture of liberal peace described by Kaldor. Countries that are not involved in development, such as Azerbaijan, use purchased autonomous weapons systems with little attention from European and North American press. The war in Ukraine is the only example of an interstate conflict with large amounts of international attention in which autonomous weapons systems have been deployed. At this point in time however, there is little certainty about the scale and specifics of RAS usage in Ukraine. While there is not currently a clearly identifiable lethal autonomous weapon system in the strictest sense of the term, it is undeniable looking at recent use of loitering munitions and other drones that robotics and autonomous systems are here to stay, and that the role they are playing in existing conflict is growing in prominence.

VIII. Conclusion

Lee's assemblage framework effectively illustrates many of the processes described in this thesis. Alignments are forged between states, multilateral organizations, and private contractors to form a type of military industrial complex that is simultaneously both globalized and localized. The perceived crises in the European and international security environments that the MvD and other institutions identify are rendered technical, presenting integration of RAS into militaries as means of crisis management by assembling the necessary bodies of expertise to develop and proliferate RAS. Authorizing knowledge is done by emphasizing the changing nature of warfare and the global security environment and incorporating discourses that stress both the need for multilateralism and adaptability, maintaining a stated commitment to international and humanitarian law, and controlling publicly available information on existing systems. One of the biggest contradictions for involved institutions is navigating the public controversy surrounding 'killer robots' and maintaining a favorable public image while simultaneously developing autonomous military systems, and this is managed by drawing the necessary expertise from networks of different actors, so that no single organization attracts too much scrutiny. The political question of RAS development is partially de-politicized by relying upon partnerships with private contractors for research and development, insisting that existing

bodies of international law are sufficient to prevent the emergence of feared killer robots, and positing that continued RAS research offers a more precise and less risky means of waging war. Finally, the assemblage is continually being reassembled in accordance with procurement needs, as while the MvD emphasizes the need for a localized base of knowledge and production, global actors are continually brought in where the need arises.

The Assemblage involved in the developing, producing and proliferating, and testing the Milrem THeMIS is able to function productively and continually incorporate actors. The Netherlands, in line with the recommendations from the AIV- CAVV report, has been able to obtain a semi-autonomous weapon system, while also publicly addressing the debate around LAWS by stating commitment to meaningful human control and existing international law. The development of LAWS in the Netherlands is not likely in the near future, as this is a major liability in terms of public relations. A full ban on LAWS, as recommended by the AIV-CAVV report, however, is also unlikely in the near future. Regardless of officially stated positions on fully autonomous weapons, states still have a vested interest in continuing research and development in the field of robotics and autonomous systems. The hesitancy of states to commit to a full ban on LAWS is likely out of concern that these commitments would create additional roadblocks for the current trajectories of research and development.

The scope of this research was of course limited by time and access. Little research on the development process of autonomous weapons systems currently exists and as Verbruggen (2019) notes, there is not widely available data on this topic. The point of this thesis was largely to survey publicly available documents for observable patterns. Future research on this topic that would not be burdened with the limitations of a Master's thesis could potentially include primary data and larger amounts of secondary data with better access. This research centered around a relatively narrow window of time and a relatively new phenomenon. As research and development continues in the coming years, further research on this topic using an assemblage approach can potentially focus on the process of reassembling over time.

There is a fundamental tension between the escalating demand for states to invest in RAS and the need for states to appear accountable to a public that is uneasy with the idea of 'killer robots'. In the aftermath of the Russian invasion of Ukraine, it is clear that investment in RAS will likely increase, though the public debate will also continue. Alexander Karp, CEO of Palantir technologies, wrote an open letter arguing that European militaries should collaborate extensively with Silicon Valley in order to deter potential Russian aggression, and sentiments such as these are being taken seriously by many states and organizations (Karp, 2022; Heikkilä, 2022). NATO announced on June 30 of

2022 that it is starting a \$1 billion (USD) innovation fund to assist robotics startups (NATO, 2022; Heikkilä, 2022). Germany and the UK, among other countries, have announced AI strategies and earmarked budgets for research and development (Heikkilä, 2022). Collective defense on the European continent has thus been rendered technical.

While the movement against lethal autonomous weapons will likely not result in the legally binding ban that it desires in the near future, the controversy does force practitioners to approach development with more caution in regards to autonomous decision-making. Fully autonomous weapons systems as popularly conceived are too much of a liability to appear on battlefields anytime soon, as this would attract political scrutiny. It is in the best interest of involved actors to depoliticize the discourse around autonomous weapons systems and refocus the conversation on questions of efficiency, precision, increased situational awareness, and interoperability. This framing renders existing issues with autonomous weapons systems as surmountable through further innovation. Meanwhile, prototypes of increasingly complex autonomous systems *are* continually being introduced to existing conflicts. This trend shows no sign of slowing.

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