Facing the Future: A Case Study of Dutch Regulatory Responses to Commercial Off-The-Shelf Unmanned Aircraft Systems and Related Safety and Security Issues

Adrian Thille Max Antoon Johan Mommers s4130073

Nijmegen School of Management, Radboud University

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Preface

This research covers the following topics. First, regulatory responses to drone technology meant to ensure both public safety and successful economic integration of drones into society. Second, the issue of ensuring security against unwanted use of drones through deterrence by denial and specific counterterrorism approaches. In this case study, it is shown why and how Dutch regulators responded to the proliferation of smaller and more affordable drones between 2015 and 2018. Understanding the Dutch responses to drone proliferation enables greater knowledge on how safety and security issues with drones can be handled. Especially, in a way that also allows for the successful economic integration of drones into society. The results are useful to understanding the subjects of drones and emergent technology governance whilst contributing to the field of Critical Terrorism Studies, and the argument for deterrence by denial.

Theory related to deterrence, and Critical Terrorism Studies, were of use for the following reasons. These theories showed how unwanted behavior with drones, be it related to safety or security, can be deterred. Furthermore, that one needs to look at the subject of terrorism by means of drones in a critical manner. First, because overemphasizing the threat of terrorism can lead to inaccurate and excessive force-based responses, or new overbearing legislation and regulation, that may cause more harm than good. Second, because the alleged threat of terrorism with drones might be a form of framing which mostly serves an interest for media attention, or an academic trend, than that of actually achieving security. Especially, when comparing the threat of delivery of harmful payloads by drones to the increased surveillance capabilities drones offer non-state actors. In the end, it will become clear how working with, instead of against, the technology of drones actually can facilitate both safety and security.

Contents

List of Figures and Tables

Chapter 1: Introduction

The Netherlands Institute for Transport Policy Analysis expects that, by 2050, in Europe, there will be 7 million drones in recreational use, 100,000 drones employed in agriculture, 50,000 drones involved in public safety, and, finally, 100,000 drones used for delivery services.[1] This thesis presents the findings of a "process tracing" qualitative single-case study on Dutch regulatory responses to the safety and security (S&S) issues of commercial off-the-shelf unmanned aircraft systems (COTS-UASs).[2] This research provides additional data intended to inform the debate surrounding COTS-UAS-related security issues and explains how the Netherlands has responded to COTS-UASs related safety and security issues.

First, a regulatory response to COTS-UAS proliferation was necessary to ensure public safety and facilitate the economic integration of COTS-UASs. Second, a policy response was required to ensure the security of the Netherlands with regard to hostile use of COTS-UASs. This research investigates whether there are gaps between these Dutch responses to COTS-UASs and what the reasons for such gaps could be. This thesis addresses both *why* and *how* Dutch regulations ensure public safety with regard to COTS-UASs while critically examining the threat of terrorism facilitated by such systems.

To allow the economic integration of drones into Dutch society to flourish public safety, and security, issues need to be addressed. Criminals and terrorists have attempted to use remotely controlled aircraft to traffic goods or strike targets in the past, to varying degrees of success. The problem that arises now is that COTS-UAS have proliferated and have become both cheaper and easier to use. This research focuses on whether regulatory responses in the Netherlands have matched COTS-UASs proliferation by applying theory on the governance of emergent technology, regulatory responses to drones, deterrence of hostile acts by denial of resources, and critical terrorism studies (CTS) to the Dutch case.

1.1 Demarcation of the subject matter

1.1.1 Time frame

This research focuses on the Dutch response to COTS-UAS technology between 2015–2018. The choice of time frame is because of the following reasons.

Up until mid-2015, it was forbidden to use COTS-UASs in any way that made money (i.e., commercially) in the Netherlands. In July 2015, Dutch regulators made the commercial use of COTS-UASs legal. Prior to July 2015, commercial use was only possible through being granted an exemption by the Human Environment and Transport Inspectorate,[3] meaning that one needed to obtain specific

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[1] The Netherlands Institute for Transport Policy Analysis, *Drones in het Personen*, 7.
[2] Yin, *Case Study Research*, 147.
[3] Research and Documentation Centre, *Het gebruik van Drones*, 159.; The Human Environment and Transport Inspectorate, *Incidents involving drones*, ABL June 2015, 1.; Mommers, *Masterwork Transcription Document*, 129-130.

permission for such operations when using an unmanned aircraft system (UAS).[4] Furthermore, recreational use of COTS-UASs was included under pre-existing model aircraft regulations in 2015.

Regulating aircraft under 150 kg has historically been a national-level responsibility for members of the EU. Whereas regulating aircraft heavier than 150 kg has been the responsibility of the European Union Aviation Safety Agency (EASA).The proliferation of COTS-UASs led to regulating aircraft under 150 kg also becoming EASA's responsibility in 2018.[5] This shift occurred was necessary due to the proliferation of COTS-UASs, the majority of which fall under the 150-kg limit, changing the playing field.

Prior to 2015, there was no specific regulation that allowed the use of COTS-UASs without an exemption. It is then clear that the development of Dutch UAS regulations and security policy can be investigated between 2015–2018, as, during this period, the Netherlands could still update its national-level regulations concerning COTS-UAS.

1.1.2 Clarifying terminology

In this research, the term unmanned aviation is understood as meaning that a human element (which can be multiple people) is piloting a craft remotely. By focusing on unmanned aviation, this thesis does not address autonomous UASs, as Dutch regulations do not include fully autonomous COTS-UAS operations.

People can freely purchase COTS-UASs online or in brick-and-mortar stores, which distinguishes these systems from self-built UASs or high-end military UASs. In reference to UASs, the term *drone* is a more colloquial term that has been popularized through various media sources and the academic literature. However, the term drone usually refers to simply the aerial element which enables flight, but not the required pilot[s] nor other necessary equipment. The term UAS refers to a "system of systems" as opposed to simply an aerial craft.[6] Therefore, the term UAS better reflects the technological complexity of modern drones. Figure 1, below, depicts the various components involved in the operation of a (small) UAS:

[4] Note: UAS can mean both unmanned aircraft system and unmanned aerial system. Terwilliger, *Small Unmanned Aircraft Systems*, xx.
[5] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 46*, 2.
[6] Terwilliger, *Small Unmanned Aircraft Systems*, 86.

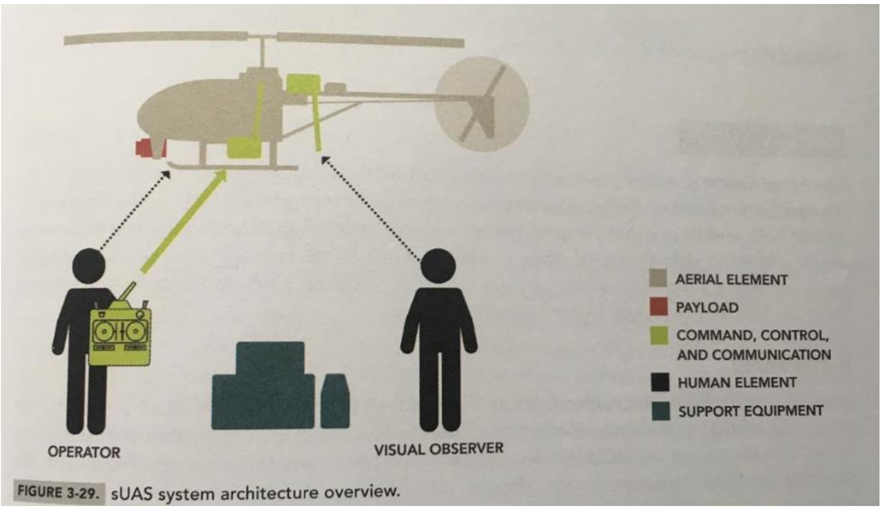

Figure 1, "small Unmanned Aerial System system architecture overview"[7]

Figure 1 depicts the various elements of a UAS. Payloads can be (audiovisual) sensors or goods, which are carried by the aerial element. The command, control, and communication equipment (C3) allows a pilot to operate the aerial element, manipulate payloads, and exchange commands and data with the UAS. Support equipment can include anything that helps in UAS operations.[8]

1.2 Research problem: The proliferation of COTS-UASs and associated regulatory issues

1.2.1 Increased ease of use and access to airspace

COTS-UASs have become easier to use due to technological advancements and have therefore proliferated in the Netherlands.[9] Ease of use has increased so dramatically that most COTS-UASs can be flown by laymen immediately after purchase (this is referred to as being able to *fly out of the box*).[10] In general, unmanned aviation challenges the status quo of any airspace, as no country's airspace was "designed to accommodate non-segregated access of unmanned aircraft".[11] COTS-UASs proliferation challenged the structure of Dutch airspace because suddenly more people could access it using COTS-UASs.[12]

1.2.2 Problems associated with regulatory responses to COTS-UAS developments

As Chapter 2 will further demonstrate, research indicates that current regulatory processes are (becoming) outdated due to the pace of technological development. In 2014, scholars Clarke and Moses noted that regulatory responses, from a wide range of countries, were not keeping pace with the increasing popularity of drones in the public domain.[13] Similarly, Vacca, Onish, and Cuccu stated stated that "The growing industry of drones is not balanced by an exhaustive regulation".[14] The potential that

[7] Terwilliger, *Small Unmanned Aircraft Systems*, 87.
[8] Ibid.
[9] Elands et al., *Technical Aspects Concerning*, 11.
[10] Mommers, *Masterwork Transcription Document*, 103.
[11] Terwilliger, *Small Unmanned Aircraft Systems*, xiii.
[12] Elands et al., *Technical Aspects Concerning*, 16.
[13] Clarke and Moses, *Public Safety*, 267.
[14] Vacca et al., *Drones: Military Weapons, Surveillance*, 51.

the capabilities of COTS-UASs may outpace their regulatory regime has also been identified in the Netherlands.[15]

However, even in 2014, some degree of progress had been made in terms of formulating regulation on the European and national levels.[16] However, both national regimes and the broader European regime did not cover the smaller category of drones, which are the kind that have proliferated throughout Dutch society.[17] This situation risks gaps between COTS-UASs and the relevant regulations in terms of public safety. With regard to the use of drones by non-state actors in conflict zones, "the gap between government and consumer drone technology is getting narrower by the day" while the importance of proper regulations to control this situation grows.[18]

1.3. Research objective and main research questions

The previously discussed issues resulted in the following research objective (RO) and corresponding main research questions (MRQs) being formulated whereas the sub-questions (SQs) are discussed in Chapter 2.

The research objective involves "process tracing" concerning the Dutch regulatory responses to COTS-UASs.[19] Process tracing occurs by focusing on *how* and *why* the Dutch responses came to be. Therefore, this research allows for the fulfillment of the following research objective:

> *To explain the evolution of the Dutch regulatory responses to the challenges posed by emergent COTS-UASs, specifically those related to safety and security*.

Based on the research objective, the following main research questions are formulated:

> *Is there a response gap between the technological development of COTS-UASs and the regulatory responses of the Netherlands in terms of safety and security issues?*
>
> *and,*
>
> *If there is a gap in terms of safety and security issues, how can this gap be explained?*

This research assesses the Dutch regulatory responses by performing document analysis through desk research and by conducting qualitative interviews with both government and non-government experts on COTS-UAS-related topics. This approach ensures both triangulation of data sources and methods in order to produce higher quality results. As a result, it provides insight into the Dutch response to safety- and security-related COTS-UASs developments.

1.3.1 Actors involved in Dutch regulatory responses

The Dutch regulators tasked with regulating COTS-UASs include the Ministry of Infrastructure and Water Management (MIWM) and the subordinate Human Environment and Transport Inspectorate

[15] Elands et al., Technical Aspects Concerning, 18, 69.
[16] Vacca et al., *Drones: Military Weapons, Surveillance* 54.
[17] Elands et al., Technical Aspects Concerning, 11.
[18] Velicovich, *Consumer Drone*, 1.
[19] Yin, *Case Study Research*, 147.

(HETI). The Ministry of Justice and Security (MiJS) has also researched COTS-UAS-related security issues and countermeasures to update Dutch security policies.

The MIWM and MiJS have both cooperated with various Dutch institutions and the Dutch military on the subject of the regulation of COTS-UASs, with the goal to regulate COTS-UAS technology to the socio-economic benefit of the Netherlands. Representatives of both ministries participated in this research.

1.4 Societal relevance

1.4.1 The societal benefit of researching the regulatory response to COTS-UASs

Researching the Dutch response to COTS-UASs proliferation is beneficial to Dutch society for the reasons presented in the following paragraphs.

COTS-UASs have been hailed as presenting economic opportunities for the Netherlands due to their potential uses in fields such as agriculture, logistics, and photo- and cinematography.[20] UASs are also a cheaper alternative to the satellites that are essential to modern data infrastructure.[21] These prospects may prove extremely beneficial to not only Dutch but also global society. There are other opportunities with unmanned aviation, such as transporting medicine to remote communities, but there can be as much beneficial uses as creativity allows. Researching the Dutch regulatory response to COTS-UAS is thus of socio-economic value to many people in and outside the Netherlands.

Whenever a new technology is introduced, there is a need to address both its positive and negative potential uses within civilian society.[22] To facilitate economic integration regulators must determine how to "incorporate new emerging uses of…drones".[23] Researching this topic is of societal importance due to predictions of a rapid increase in UAS usage in the civilian sector in the future.[24] This industry is expected to grow into one that is worth billions of dollars over the next two decades.[25] If this predicted growth were to occur, the importance of safety and security issues associated with COTS-UASs will only increase.

Alongside this market growth, UASs themselves are likely to "become smaller, lighter, cheaper, and more efficient".[26] Therefore, this technology will "become more widespread while its potential uses will increase".[27] Thus, alongside increasing numbers of COTS-UAS, society will also need to deal with their growing capabilities. Should society not have the necessary information on which to base informed regulatory decisions, the process of realizing the positive gains offered by COTS-UAS will be hindered.

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[20] van Dijk, *Dossier Drone: Nieuwe Kijk*, 52-57.
[21] Roma, *Drones and Popularisation*, 2.
[22] Vacca et al., *Drones: Military Weapons, Surveillance,* 62.
[23] Ibid.
[24] The Netherlands Institute for Transport Policy Analysis, *Drones in het Personen,* 7.
[25] Terwilliger et al., *Small Unmanned Aircraft Systems*, 28.
[26] Custers et al., *Het gebruik van drones*, 10; my translation.
[27] Ibid; my translation.

1.4.2 The importance of researching COTS-UASs as a case study on challenges in the governance of emergent technologies

Looking forward, understanding the early years of the Dutch response process is helpful in better addressing future developments with drones but also other technologies. Understanding any challenges that Dutch regulators faced with COTS-UASs will help in regulating existing and future emerging technologies.

COTS-UASs are an emergent technology, as are nanotechnology, self-driving cars, and artificial intelligence. However, COTS-UASs are further in their development cycle than these other technologies. Therefore, before artificial intelligence or nanotechnology can become widespread, research can consider the regulatory issues associated with the adoption of COTS-UASs to identify general issues in governing emergent technology. Not researching this subject may lead to challenges or opportunities associated with emergent technology governance remaining unidentified or unaddressed.

To summarize, many societies will likely be negatively affected if the technological development of COTS-UASs outpaces their regulatory processes, either as a result of not exploiting the economic integration of these systems to its full potential or due to harm as a result of safety or security issues.

1.4.3 Societal relevance of S&S issues associated with COTS-UASs

1.4.3.1 Safety:

The societal relevance of researching safety issues is as follows: The airborne nature of COTS-UASs comes with its own safety issues, both during safe operations and in the case of accidents.[28] An example of such an issue is keeping various forms of manned and unmanned aviation from colliding with each other or impacting those on the ground.

Clothier, Greer D.A., Greer D.G., and Mehta state that “Guiding the development of safety regulations for drones is a high-level safety objective”.[29] This is because regulations act as a safeguard against the threats that COTS-UASs pose to public safety.[30] Therefore, it is worrisome that, with regard to drones, “the risk of accidents both digital and physical are destined to multiply” as this technology proliferates in society.[31] In particular, given the public safety risks with small and light COTS-UASs and the corresponding slow speed of regulatory responses to those lighter COTS-UASs.[32]

Regulatory responses to COTS-UASs relate to safety issues in the following manner:

> Public safety depends on regulatory forces being sufficient to encourage safe practices in the manufacture and deployment of drones, while the future of the industry depends on avoiding unnecessary and unhelpful constraints on the design and use of drones.[33]

Therefore, a regulatory response can address safety issues by requiring that COTS-UASs flown in Dutch airspace are both *designed* and *used* safely. Mandating that certain features are incorporated into COTS-

[28] Clarke and Moses, *Public Safety*, 263.
[29] Clothier et al., *Risk Perception*, 1168.
[30] Clarke and Moses, *Public Safety*, 268.
[31] Rao et al., *The Societal Impact*, 89.
[32] Clarke and Moses, *Public Safety*, 280-281.
[33] Clarke and Moses, *Public Safety*, 281.

UASs in the interests of public safety is called as safety-by-design. However, safety should be assured without creating an unnecessarily strict regulatory regime. because excessive strictness can lead to harmful consequences for the public or discredit the existing regulatory regime or result in it falling into disrepute, which can only make matter worse.[34]

There is a clear societal benefit in ensuring proper regulation of COTS-UASs because of the benefits that such innovations offer; in addition, it is important to ensure public acceptance of such regulations. The latter is particularly important because the public image of regulators affects the trust between them and those subject to regulation.

1.4.3.1 Security:

The proliferation of COTS-UASs has empowered people to engage in benign activities such as starting their own businesses or providing COTS-UAS-based services that benefit Dutch society. However, this proliferation also serves people with malign intentions. Similarly to safety issues, regulations on COTS-UASs also have the potential to improve security through mandating the inclusion of security-by-design features. Without proper regulations, unwanted criminal and terrorist usage of COTS-UASs becomes more likely.[35]

Security-related regulations or policies intended to deter malevolent use of COTS-UASs can increase the deterrence of harmful uses of COTS-UASs. Although this research generally focuses on terrorism, criminal use is occasionally discussed by means of example. It is of societal importance that security issues be addressed adequately but not to the detriment of law-abiding citizens, as overzealous regulators can lead to measures that negatively people’s individual civil liberties without actually facilitating security.[36]

1.4.4 How improving safety with COTS-UAS contributes to security

The first reason for discussing terrorism is that measures that can facilitate the successful economic integration of COTS-UASs, and enhance public safety, are also helpful in terms of providing security. The second reason is that the potential use of COTS-UASs by terrorists influences the overall debate on the use of drones by the public.

Both S&S can be enhanced by allowing the (COTS-)UAS sector to mature and by implementing multiple systems of registration, detection, and attribution. The Netherlands Organization for Applied Scientific Research (NOASR) describes this process of increasing S&S, through implementing the aforementioned systems, as follows:

> The overall idea of establishing an air traffic management system is that the air picture is built up through a number of different sources (detection, transponders, flight plans, apps, et cetera), which ensures a redundant and reliable system. Even so-called non-cooperative drones, aircraft without for instance a transponder, could be localized through various means of detection.[37]

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[34] Ibid, 280-281.
[35] Altawy et al, *Security Privacy Safety Aspects*, 2.
[36] Jackson et al., *Terrorism,* 235.
[37] Elands et al., *Technical Aspects Concerning*, 59.

The research briefly moves to its results because in the interviews conducted for this research the importance of being able to detect and attribute non-cooperative drones, for both safety *and* security, was confirmed.[38] Therefore, increasing transparency with regard to the real-time use of COTS-UASs would not only facilitate public safety but also increase security.

Increasing transparency into COTS-UASs operations is of further importance to society and security given that the success of terrorist activities relies on terrorists "being able to maintain an element of surprise".[39] Therefore, it is of societal importance to determine whether registration, detection, and attribution was part of Dutch regulatory responses and what else can be learned from the Dutch case. To conclude, by increasing registration, detection, and attribution, regulations can increase levels of safety *and* security to the benefit of the Netherlands and to the detriment of terrorists and criminals.

1.5 Scientific relevance

There has been significant academic discussion on public safety issues associated with (COTS)-UASs; however, questions still remain as to how the challenges associated with integrating drones into society can be solved.[40] In the following ways this research assesses the Dutch regulatory response to COTS-UAS security issues from a new perspective. First, this study applies concepts from the field of CTS and the argument for deterrence by denial (DBD) to COTS-UAS-related security issues. Second, this research is critical of the framing of COTS-UASs and an explanation for this critique is given in section 1.5.2.

1.5.1 The importance of providing data to inform the debate surrounding the terrorist use of COTS-UASs

Drones and their use in recent conflicts have been extensively researched in academia.[41] In particular, the use of drones by terrorists to deploy unconventional payloads has been discussed and theorized upon by many academics.[42] As a result of the increased availability of drones on the civilian market, certain capabilities previously reserved to the military and law enforcement have become available to civilian actors.[43] Modern UASs can deploy weapons or explosives, crash into a target with a kamikaze attack, and/or disrupt other aircraft.[44] However, an excessive focus on the use of weaponized COTS-UASs leads to a failure to recognize the fact that terrorists predominately use such systems for surveillance and communication purposes.[45]

In fact, recent research has shown that "single drones have been used by terror entities primarily for surveillance and strategic communications, and it is in this area where terrorists have made the most gains".[46] Therefore, a focus on the use of COTS-UAS to kill people by means of harmful payloads may be

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[38] Mommers, Masterwork Transcription Document, 126.
[39] Rassler, *The Islamic State Drones*, 23.
[40] Rao et al., *The Societal Impact*, 83.
[41] Clarke and Moses, *Behavioral Privacy*, 287.
[42] Clarke, *Understanding the Drone*, 242.
[43] The Remote Control Project, *Hostile Drones*, 3; Clarke. *Understanding The Drone*, 242.
[44] Clarke, *Understanding The Drone*, 241.
[45] Rassler, *Remotely Piloted Innovation*, V, 47.
[46] Ibid., V.

unjustified. Therefore, this thesis critically considers terrorist use of COTS-UASs because terrorism with COTS-UASs may have led to bias concerning such systems in the Netherlands.

However, the academic interest in the use of COTS-UAS is understandable the emerging interest in hybrid warfare in the field of conflict studies and international relations. Specific to conflict studies, the use of cheap COTS-UASs in tandem with other more conventional military equipment in conflicts represents a form of hybrid warfare.[47] The following quotations explain this observation further: concerning the Battle of Mosul (2016–2017), Watson stated that "ISIS dispatches several kinds of drones easily acquired online".[48] An anonymous U.S Military official interviewed by Watson stated "Most of what they have is very primitive, bought from hobby shops, modified," which signifies that terrorists are using COTS systems.[49] ISIS used these drones to drop grenades onto forces below, transport explosives, and conduct surveillance. In addition, members of this group left booby-trapped for enemies to find.[50] The use of such technology in the production of terrorist propaganda material (e.g., the filming of IED attacks) is also well-documented.[51] Researching the use of COTS-UASs by terrorists is important in understanding the security threats associated with their use by non-state actors. However, this research is careful to not contribute to a negative framing of COTS-UASs simply due to a desire to attain academic recognition.

1.5.2 Why framing COTS-UASs as tools for terrorism can be problematic

When discussing the "instrumentality" of terrorism, Jackson et al., state that "media exposure functions as an amplifier of terrorist violence"[52] and, furthermore, that the casualties that terrorism produces serve as an instrument for achieving purposes beyond the deaths of victims.[53] Given that, "For non-state actors, the easiest way of communicating a message is through the generation of maximum publicity via media coverage," it is worrisome that cases involving the malevolent use of drones often receive such media attention.[54] The phenomenon of COTS-UASs receiving negative media attention has also been described as the:

> …quick tendency of the media to hype terror UAS incidents even when no demonstrated threat existed, an issue that could push terror groups to select drones over other options in the future.[55]

Terrorists might use COTS-UASs purely because it is the easiest way of either achieving media attention as a result of the media providing terrorists with the "oxygen of publicity" when COTS-UASs are involved in terrorist attacks.[56] Consequentially, as a result of being portrayed as an extremely dangerous threat by the media, the appearance of COTS-UASs might prompt excessive emotional reactions (e.g. panic)

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[47] Rassler, *The Islamic State Drones*, V, 24.
[48] Watson, *The Drones of Isis*.
[49] Ibid.
[50] Ibid.
[51] Rassler, *Remotely Piloted Innovation*, 24.
[52] Jackson et al., *Terrorism*, 118.
[53] Ibid.
[54] Ibid., 116.
[55] Rassler, *Remotely Piloted Innovation*, 44.
[56] Jackson et al. *Terrorism*, 118, 119.

among members of the public.[57] Therefore, this research is of scientific relevance in that it seeks to provide accurate information concerning how such potential negative biases can be countered. In the absence of such data, undue emphasis on the harmful uses of COTS-UASs may remain.

1.5.3 Scientific relevance of investigating the effect of regulation of COTS-UASs in the Netherlands

The scientific relevance of researching the relationship between regulation and COTS-UAS-related safety issues is derived from the work of Clarke and Moses. The authors stated the following with regard to regulations intended to address safety issues associated with small COTS-UASs: “co-regulation, industry self-regulation and organizational self-regulation identified very little in the way of initiatives that might plug the gaps left by inadequate and very-slowly-adapting formal regulation”.[58] This observation indicates that, in 2014, these other forms of regulation were found to not compensate for a lack of formal regulations from national and European governments. While Clarke and Moses considered the European case, they did not specifically focus on the Netherlands. However, there are signs that co-regulation with the Dutch UAS sector did occur in the Netherlands and that such co-regulation had many beneficial effects on the regulatory regime.

Focusing primarily on formal regulation represents a scientific advantage because information on Dutch formal regulation is more accessible than that on other forms of regulation. However, by also interviewing Dutch UAS experts and regulators, it is possible to obtain insight into Dutch co-regulation. Therefore, researching the Dutch case contributes to an understanding of effective regulation of COTS-UASs and expands on the work of Clarke and Moses.

1.5.4 Scientific relevance to critical terrorism theory and deterrence theory

To address security-related issues, the research adopts a CTS perspective from Jackson et al., which is complemented by deterrence theory that deals with terrorist use of emergent technologies and how this can be discouraged through methods of denial.[59] The CTS perspective is founded on the view that the term terrorism is ambiguous in meaning and socially constructed; thus, one needs to critically consider what measures could be taken against different conceptualizations of terrorism.[60] However, a critical perspective on terrorism involves more than critiquing terrorism as a stable, objective concept; rather, research should also “suggest alternative and credible future research agendas”.[61] This is done by considering how regulation, deterrence, and specific approaches to counterterrorism contribute to security with regard to COTS-UASs; and whether certain security threats associated with COTS-UASs are overemphasized in the debate. The relevance of studying the role of deterrence is indicated by the previous research finding that “it is more difficult to deter individuals, regardless of technology, than to deter nation-states”.[62] The importance of deterring individuals relates to how the increased proliferation of COTS-UASs empowers individuals to access airspace with off-the-shelf technology.

[57] Beesley, *Drone Panic! On representations*, 1-2.
[58] Clarke and Moses, *Public Safety*, 280.
[59] Geis and Hailes, *Deterring Emergent Technologies*, 47.
[60] Jackson et al., *Terrorism*, 2-3.
[61] Ibid., 45.
[62] Geis and Hailes, *Deterring Emergent Technologies*, 61.

To conclude, an important academic contribution of this research is that it explores how it is possible to deter hostile uses of COTS-UASs by individuals through regulation, S&S by design, and deterrence by denial.

1.5.5 The importance of including countermeasures as a means of security

Concerning countermeasures to malevolent use of drones, scholars from the Remote Control Project stated that "time and resource investments should be prioritized for countermeasures that respond to the scenarios with highest risk (high likelihood/high impact)".[63] This observation implies that one should address the worst-case scenarios first. To explain the link between regulation and countermeasures against hostile drones this study draws upon the hierarchy of countermeasures against drones. This hierarchy is presented by the Remote Control Project and is depicted in Figure 2, below:

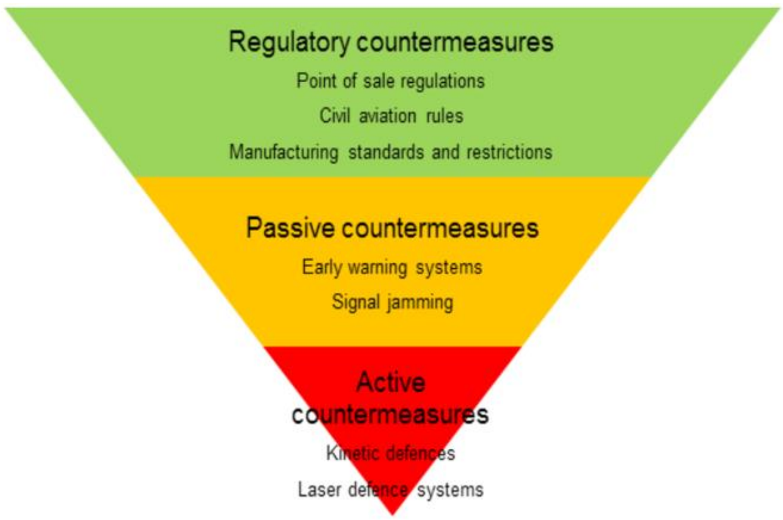

Figure 2, The Hierarchy of countermeasures.[64]

Regulatory countermeasures are particularly relevant to this research because these measures can both help prevent accidents and/or limit the potential for attacks involving drones through a combination of governmental and industry policies.[65] The Remote Control Project's example of a regulatory countermeasure would be mandating pre-programming all brands of drones with built-in no-fly zones (geofencing).[66]

However, the fact that regulations alone will not prevent people from purchasing non-regulation-compliant UASs on the black market, or building their own, reflects the importance of

[63] The Remote Control Project, *Hostile Drones*, 15.
[64] Ibid., 14.
[65] Ibid., 15-16.
[66] Ibid., 15.

researching the role of both passive, active, and regulatory countermeasures.[67] To adequately represent the Dutch response to the proliferation of drones, the role of regulatory but also passive and active countermeasures needs to be addressed. Because, passive and active countermeasures will be necessary to ensure security against non-regulation-compliant drones due to the *displacement effect* discussed in Chapter 2.

1.5.6 Complications associated with passive and active countermeasures

Furthermore, it is also important to consider the types of countermeasures that can be employed due to the need to eliminate COTS-UAS-related threats without having the craft or payload crash, thus potentially endangering the public.[68] Simply stopping a craft by force is not enough because a drone (or its potential payload) can still cause harm to people or infrastructure.[69] This complicates attempts at ensuring domestic security because simply shooting down COTS-UASs is undesirable outside of conflict zones. Therefore, there may be additional applications for regulatory and passive countermeasures to hostile COTS-UASs. Due to the aforementioned complexities, it is important to assess the development of Dutch countermeasures to determine what can be done in response to a drone-based attack and how one can prevent drones from causing damage by crashing in unintended places.

Therefore, the researcher asked experts questions concerning the development of approaches to detecting and countering hostile UASs that have been adopted in the Netherlands. The interviews were conducted with the intent of portraying the reality of the safety and security situation, identifying proportionate and effective (regulatory) measures, and countering any negative framing of COTS-UAS-related security issues.

1.6 Scope and other UAS-related topics

The use of (COTS)-UASs, both in and outside of combat zones, has attracted much attention over the years. Contemporary discussions revolve around the “acceptable and unacceptable use[s]” of drones as per the perception of the civilian populace.[70] Various legal debates on drones have discussed these systems as causing conflict between existing rules, their potential in terms of technological development, and the threat that they pose to overall public safety.[71] There is also the view that drones (particularly military types) make the use of violence as a means to an end easier.[72] Finally, there are privacy concerns associated with COTS-UASs, both in terms of capturing digital data as well as making unwanted audio-visual recording of individuals.[73] Privacy issues are often discussed with reference to camera-equipped drones, but also in terms of COTS-UASs ability to capture non-visual data, such as sound, IP addresses, and internet traffic.[74]

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[67] Mommers, Masterwork Transcription Document, 19, 44, 88, 91. This idea was found in the results and will be presented later.
[68] Elands et al., *Technical Aspects Concerning*, 24.
[69] Ibid.
[70] Boucher, *Drawing Boundaries*, 1403.
[71] Clarke and Moses, *Public Safety*, 263.
[72] Beard, *Law and War*, 443.
[73] Altawy et al., *Security Privacy Safety Aspects*, 18-19.
[74] Marzocchi, Privacy and Data Protection, 21.

Due to this study being a master's thesis, it could not address all of these subjects in relation to the Dutch case, as the resources required to conduct a study on that scale were not available. However, the findings of a single-case study on the Netherlands may inform future multiple-case studies in the following ways.

First, this thesis may prove helpful in determining whether the regulations implemented in the Netherlands were effective in terms of addressing drone-related public safety issues and how these regulations evolved. Second, this thesis contributes by adopting a critical perspective on COTS-UAS-related security issues and determining which certain counterterrorism approaches are appropriate in addressing such threats. Finally, a better understanding of S&S issues related to COTS-UASs can further facilitate the beneficial economic integration of COTS-UASs into Dutch society. With regard to the topic of the governance of emergent technologies, the knowledge gained from analyzing the Dutch case may prove helpful in future (case) studies.

Chapter 2: Theoretical Framework

The following theoretical framework allows an analysis of the Dutch regulatory response to the proliferation of COTS-UASs. Following the theoretical review, grander theories—namely those that deal with regulation as a form of societal response to the emergence of new technological developments—are discussed. Finally, security issues are addressed by the incorporation of both deterrence and CTS theory.

2.1 Theoretical review

Multiple scholars have recognized that technological development can occur at a rate that is disproportionate to the development of a society's capability to interact with or respond to technology.[75] It is important to understand that this can occur not only due to the development of technology but also due to an inability, or even unwillingness, on the part of a society to respond adequately.[76] The following sections present multiple ways in which response gaps to technological developments can arise.

First, the progress of technological development can occur at a rate that outpaces the development of societal responses to a technology.[77] A subsequent gap between technology and a corresponding response can then be harmful to the members of the engaged society.[78] To cope with this potential problem, societies should prepare for (or anticipate) the possible consequences, both positive and negative, of technological development.[79]

Second, technological developments do not occur in a vacuum. Beyond the risks that a technology poses in and of itself, it can also pose new threats to society when it develops alongside other developing technologies with a similar potential for social impact.[80] Should the development of technology continue, or should the rate at which technology evolves change, the associated risk will increase.[81] Therefore, greater trouble can arise when the frequency of new technologies (entering society) increases yet society proves unable to formulate a response to each innovation.[82]

The simultaneous development of other technologies may enable new forms of conduct, again at a pace that might surpass a society’s ability to respond, resulting in the creation of so-called “compound effects”.[83] A compound effect is the result of a combination of multiple (new) technologies. In such situations, it is crucial to be vigilant and to monitor the rapidly increasing technological changes and how they interact with each other.[84]

Third, technological developments raise the question of whether existing power dynamics among parties in society will be altered in a positive or negative manner.[85] The way this alteration of

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[75] Morison, *Men, Machines, Modern Times*, 15, 19.; Toffler, *Future Shock*, 35.; Orman, *Technology as Risk*, 25.
[76] Morison, *Men, Machines, Modern Times,* 10.
[77] Morison, *Men, Machines, Modern Times*, 15-19.; Toffler, *Future Shock*, 28-29.; Orman, *Technology as Risk,* 25. Marchant and Wallach, *Coordinating Technology Governance*, 4.
[78] Morison, *Men, Machines, Modern Times* 15, 19.; Toffler, *Future Shock,* 35.
[79] Kelly, *What Technology Wants*, 173.
[80] Orman, *Technology as Risk*, 23.
[81] Ibid., 24.
[82] Ibid., 25.
[83] Ibid., 25.
[84] Toffler, *Future Shock,* 3-4.
[85] Sandler, *Ethics And Emerging Technologies*, 10.

power dynamics works is that emergent technology can allow for "new forms of conduct, including alteration of the means by which similar ends are achieved".[86] In the relevant academic literature, it has been recognized that such technology will only continue to develop "at an exponential rate".[87] In the related debate, there is a consensus that societies need to respond to technological developments and identify any problems that might be associated with a particular technology.

However, the question remains *how* specific responses to technological developments can best deal with the speed or rate of technological change, the compound effects that may arise from the interactions among technologies, and power shifts in society. This question led this research to theory on connecting (or re-connecting) regulations to technological developments. Because, this approach both considers a technology, its direct users and indirect stakeholders, and the regulatory regime itself in terms of determining how a society should respond to technological developments.

2.2: Theories related to regulatory responses to emergent technologies

2.2.1: Public safety

2.2.1.1 Brownsword's theory on regulating new and rapidly changing technologies

The theory used to assess the Dutch response to safety issues is borrowed from Clarke and Moses (2014), who in turn built upon the theory of Brownsword (2008). By first discussing Brownsword, it is possible to identify important elements in terms of regulating emergent technology. Brownsword deals with the issue of the "'regulatory connection'" to technology in general, whereas Clarke and Moses specifically address drones.[88] Before moving on, it is necessary to define what is meant by the term regulation. The following definition has been utilized by multiple scholars:

> …the sustained and focused attempt to alter the behaviour of others according to standards or goals with the intention of producing a broadly identified outcome or outcomes, which may involve mechanisms of standardsetting, information-gathering and behaviour modification.[89]

Therefore, regulations aim at encouraging or discouraging certain behaviors in accordance with the wishes of regulators.[90] The goals that regulators wish to achieve encompass "'…economic, social or environmental policy objectives.'"[91] In the context of this thesis, the term regulations refers to regulatory or policy measures taken by the Dutch ministries to influence behavior in pursuit of their safety and security objectives.

2.2.1.2 Four issues associated with technology regulation

Brownsword states that the regulation of new technologies involves issues in terms of regulatory legitimacy, effectiveness, connection to the reality of the technology, and cosmopolitanism.[92] The regulatory aspects that need to be considered vary by technology, meaning that different issues might arise with different technologies as "hotspot[s]" that needs to be addressed.[93] In the Dutch case,

[86] Moses, *Recurring Dilemmas*, 245.
[87] Geis and Hailes, *Deterring Emergent Technologies*, 48.
[88] Qtd, in Clarke and Moses, *Public Safety*, 267.
[89] Qtd. in Ibid.,; Qtd. in Brownsword, *Rights Regulation Technological Revolution*, 6.
[90] Clarke and Moses, *Public Safety*, 267. Brownsword, *Right, Regulation Technological Revolution*, 6-7.
[91] Qtd. in Clarke and Moses, *Public Safety*, 267.
[92] Brownsword, *Rights Regulation Technological Revolution*, 25.
[93] Ibid., 26.

hotspots include effectiveness in ensuring public safety, connection to the reality of COTS-UASs developments, and cosmopolitan challenges. Of interest is whether Dutch regulation is effective in achieving S&S and whether it adequately addresses the reality of the technological development of COTS-UASs by staying connected to developments. Finally, whether cosmopolitan challenges occurred due to the cross-border nature of aviation technology and accompanying regulation.

Legitimacy is not a hotspot in the Dutch case because interviewed experts indicated that they would have preferred regulations to be imposed sooner with more frequent updates. In fact, regulation on COTS-UAS was quite desired by UAS actors and stakeholders because adequate regulation communicates what is expected of the UAS sector and further enables investments. However, should regulations not be appropriately connected to technological development the risk of the regulatory regime's legitimacy being damaged arises.[94] The importance of effectiveness and connection will become clearer throughout this chapter. For now, understanding the issue of cosmopolitanism in technology regulation is necessary.

2.2.1.3 Technology regulation and cosmopolitanism

With regard to the regulation of technology and cosmopolitanism, there is a tension between the desire to regulate technology fairly and on a global level on the one hand and the interests, rights, and morality of individual nations on the other.[95] The need to fairly regulate technology in a similar manner across borders is important; however, there can be cultural and geographical conditions that constitute "legitimate difference[s]" between cultures that surpasses the need for more global regulation.[96] To elaborate on the issue of cosmopolitanism in regulating technology,

> the challenge is to find effective ways to secure compliance with international or regional regulatory articulations of fundamental values while empowering national regulators who strive to seek compliance with local standards.[97]

The issue of the cosmopolitanism is highly relevant to the Dutch case because the European regulations on COTS-UASs, introduced in Chapter 1, heavily influenced the Dutch regulatory response.[98] This was because Dutch regulators wished to conform to the European regulations to the greatest extent possible.[99]

In order to allow the COTS-UAS sector to grow, a "level playing field" was required in Europe in terms of rules and regulations.[100] The case of Europe taking over the regulatory responsibility of all aircraft under 150 kg reflects Brownsword's notion that regulators operate "in a world where the tendencies towards globalization are accelerated by new technologies".[101] However, the pursuit of this level playing field risks that local, national level, interests were subordinated in order to European

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[94] Clarke & Moses, *Public Safety*, 280-281.
[95] Brownsword, *Rights Regulation Technological Revolution*, 185.
[96] Ibid.
[97] Ibid., 186.
[98] Tweede Kamer der Staten-Generaal, *Kamerstuk 30806 NR. 36*, 14.
[99] Tweede Kamer der Staten-Generaal, *Kamerstuk 30806 NR.* 31, 3-4.
[100] Mommers, *Masterwork Transcription Document*, 136.
[101] Brownsword, *Rights Regulation Technological Revolution* 186.

interests. Thus, this research needs to cover cosmopolitan challenges that may have occurred in the Dutch case.

2.2.1.4 Technology as a tool for regulation: an opportunity and a threat

Using technology itself as a regulatory device involves making a distinction between two categories, namely, "those (panopticon) technologies that are designed to monitor and detect non-compliance and those (exclusionary) technologies that are designed to eliminate the option of non-compliance".[102] With regard to the option of designing technology to eliminate certain options, the following points are important. Technology can be designed to *include* desired behavior, making deviation unlikely or impossible, or to *exclude* unwanted behavior. Brownsword refers to these two goals as "design-in" and "design-out" respectively.[103]

2.2.1.5 Examples of regulating through technology with COTS-UASs

With COTS-UASs, by-design features can either only allow one to engage in the desired behavior or mitigate the damage from intentional or accidental harm. Geofencing is a form of design-in feature that prevents a COTS-UAS from accessing restricted airspace. With regard to COTS-UASs, geofencing means that designated areas are fenced-off electronically, ensuring that such aircraft are unable to fly in those areas. Even should a pilot wish to fly into such a designated area, the craft itself would not allow it. When taken to the extreme, such features would mean that only desired behaviors are designed into COTS-UASs.

Even when design-out features are taken to the extreme, users can still engage in unwanted behavior with COTS-UASs, but the potential negative consequences thereof are designed out. For example, propeller guards protect against harm from a COTS-UAS' propellers in case of a collision. Other design-out features can protect against accidents (safety) or even intentional harm (security). So, while propeller-guards do remove the potential of contact with the propellers, they do not rule out the possibility of a collision.

2.2.1.6. Government versus governance and the peculiar case of small UASs

Over the last decades, regulation has shifted from a top-down enforcement of the rules of the "'government'" towards more cooperative and lenient forms of "'governance.'"[104] However, Clarke and Moses identify the opposite scenario with regard to drones. They believe that small UASs (which fell under more lenient g*overnance* in the past) are being brought under stricter manned aviation rulesets, which are older tools of *government* that were not designed with unmanned aviation in mind.[105] Therefore, where other developments were transitioning to more lenient governance COTS-UASs were being brought under stricter manned aviation regulations in 2014.

If COTS-UASs are placed under existing regimes, "the regulatory regimes designed for older technologies may fail to achieve their purpose in the new context".[106] With regard to COTS-UASs, this means that, even though they are airborne systems, they may require regulation from a different

[102] Ibid., 302.
[103] Ibid., 302, 305.
[104] Clarke and Moses*, Public Safety*, 267.
[105] Clarke and Moses, *Public Safety*, 267.
[106] Ibid.

perspective than that applied to traditional aviation. However, COTS-UASs have already been subjected to older regulatory regimes.[107]

Clarke and Moses specifically mention model aircraft regulations and previously established manned aviation regulations as examples of older regulatory perspectives applied to COTS-UASs.[108] These are particularly relevant examples in the Dutch case because the Dutch applied both of these to COTS-UASs. It is in this application of older perspectives to new technologies that regulators run the risk of losing the connection, mentioned by Brownsword, to a technology's reality.

2.2.2 Emergent technology governance: challenges and solutions

The following subsection discusses a solution based on one suggestion Brownsword proposes with regard to the reconnection problem, namely that a group or organization should bring together relevant technology stakeholders and their knowledge to support regulators in staying connected to the reality of the technological development of COTS-UASs.[109] As a solution to the challenges associated with the governance of emergent technology, Marchant and Wallach (2015) also argue for the creation of a new institution to manage emergent technologies. More specifically, they suggest the creation of an institution called a *governance coordination committee* (GCC). By considering the proposed benefits of a GCC, this thesis can determine whether the solutions the GCC may have provided were applied in the Dutch regulatory response to COTS-UASs. To discuss such potential solutions, the related challenges they are meant to address need to be understood. The following challenges and solutions demonstrate how the issues identified in the theoretical review further apply to Brownsword's theory.

2.2.2.1 Challenges in governing emergent technology

2.2.2.1.1 The rate and acceleration of technological development

The first issue to be discussed is the rate and acceleration (R&A) of technological development, which was also mentioned in the theoretical review. Rate refers to how *often* technology develops, whereas acceleration means the *speed* at which this development takes place. Furthermore, as R&A increases so do the capabilities that innovations offer to individuals, groups, and states.[110] A resulting issue is that technology is granting more power to individuals than ever, which results in a greater number of potential actors who can have increasingly large impacts.[111]

2.2.2.1.2 The state of existing regulatory processes as a challenge to formulating new responses

Another issue with current emergent technologies is that as R&A increases technological developments are outpacing the ability of "traditional governmental regulatory oversight, which appears to be slowing down rather than speeding up".[112] In Europe, it was found that regulators were not "adapting existing aviation rules sufficiently rapidly" regarding the rapid proliferation of smaller types of UASs.[113] Logically, this poses the risk of an increasing gap between these processes. In other words, it will be necessary to investigate whether response gaps arose in the Netherlands due to either the rate

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[107] Ibid.
[108] Ibid..
[109] Brownsword, *Rights Regulation Technological Revolution*, 288.
[110] Geis and Hailes, *Deterring Emergent Technologies*, 48.
[111] Ibid., 49-50.
[112] Marchant and Wallach, *Coordinating Technology Governance*, 4.
[113] Clarke and Moses, *Public Safety*, 278.

and/or the acceleration of the development of COTS-UASs, the state of Dutch regulatory processes, or a combination of both.

2.2.2.1.3. The challenge of a plurality of actors, stakeholders, and information

Another major challenge for the governance of new technologies is the number of actors involved in the governance process.[114] Beyond the government organizations involved in governance, there are also non-government stakeholders, such as businesses, the media, and universities, that influence the debate and want their voices to be heard. [115] These different stakeholders, all of whom have differing interests, can complicate the governance process. Potential problems include "inconsistent recommendations, duplication of efforts, and general confusion" at the cost of benefits.[116] A regulatory response to novel technology may also be fragmented instead of unified, thus causing confusion as to who is responsible for governing that particular emergent technology.[117] All of these factors adversely affect regulators' ability to stay connected to technological developments.

Similarly to Marchant and Wallach, Clarke and Moses also emphasize the plurality of parties involved with COTS-UASs.[118] Based on these authors' observations, there is thus a need to coordinate relevant parties and their knowledge not only when governing new technologies in general but when regulating COTS-UASs in particular. Furthermore, Marchant and Wallach state that

> The increasing number and diversity of research trajectories, applications, and participants within each emergent technology category have complicated matters further because, unlike previous fields of innovation, most emerging technologies are not limited to a single industry sector or application.[119]

This observation indicates that it is not just the plurality of those who are specifically involved with COTS-UASs that is important; instead, there are now many other industries and businesses with an indirect stake in the UAS industry. The involvement of so many parties can lead to regulators having to take a broader range of actors and interests into account in an already complicated regulatory process. It is then important to determine whether, or how, the plurality of actors and stakeholders associated with COTS-UASs complicated the Dutch regulatory response. To conclude, R&A, the state of existing regulatory frameworks, and an increasing plurality of parties all pose challenges to Brownsword's ideal of keeping regulation effective and connected to a technology.

2.2.2.2. Solutions to the governance challenges associated with emergent technologies

2.2.2.2.1 Changing perspectives

Brownsword states that a potential solution to the (cosmopolitan) challenges associated with emergent technologies is seeking new perspectives and different ways of regulating, such as using technology as a regulatory instrument, as discussed previously.[120] From Brownsword then comes the idea that governance of new technology can benefit from new ways of thinking about both technology and regulation. On the topic of drones, Marchant and Wallach warn that established aviation institutions

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[114] Marchant and Wallach, *Coordinating Technology Governance*, 1.
[115] Ibid., 2.
[116] Ibid.
[117] Ibid., 5.
[118] Clarke and Moses, *Public Safety*, 268.
[119] Marchant and Wallach, *Coordinating Technology Governance*, 4.
[120] Brownsword, *Rights Regulation Technological Revolution*, 211.

(such as the American FAA) might overlook “issues and expenses” that a GCC may have identified.[121] This observation is important, as it indicates that UASs may require regulators to not operate from an established (aviation) mindset or within pre-established regulatory frameworks. This point was also mentioned by Clarke and Moses with regard to the application of strict manned aviation regulations to small UASs.[122] Therefore, governing new technologies may require new perspectives and equally novel regulatory processes. Deterrence theory also argues for the need for “new thinking regarding the application of deterrence theory–particularly deterrence by denial” because individuals are harder to deter than groups or nations when it comes to using emergent technology.[123]

Public safety issues may occur with COTS-UASs because rules that have proven effective with regard to either manned aviation or model aircraft are *ineffective* when applied to unmanned aviation. This can be a consequence of an excessive reliance on established ways of thinking or existing regulations in formulating responses to new technologies.

2.2.2.2.2 Solving challenges by bringing regulators, actors, and stakeholders together

There are also potential benefits to the aforementioned plurality of actors and stakeholders. For example, the business community can help in addressing the governance challenges associated with emergent technologies.[124] However, to do so, they need to be included in the regulatory process. A GCC should be responsible for managing the interests of different stakeholders in order to improve the quality of governance and ensure the development of appropriate rules and regulations.[125] A solution to the challenges associated with the governance of emergent technology is then to involve relevant actors, their expertise, and any relevant knowledge that they may possess, in the governance process.

Promoting communication and coordination is thus a solution to the following problem: “as innovation increases at an exponential rate, our ability to understand, contain, and control new concepts and technology is threatened”.[126] Specifically, this thesis can then determine whether and how communication and coordination among Dutch parties occurred and what effect(s) this had on the regulation process.[127]

2.3 Conceptual model

The discussed theories and their influence on regulatory responses to technological developments are visually depicted in Figure 3. The following figure represents the lens, built from the used works of other academics, through which this research assesses the Dutch regulatory response to the public safety issues associated with COTS-UASs.

[121] Marchant and Wallach, *Coordinating Technology Governance*, 3.
[122] Clarke and Moses, *Public Safety*, 267.
[123] Geis and Hailes, *Deterring Emergent Technologies*, 47.
[124] Marchant and Wallach, *Coordinating Technology Governance*, 2.
[125] Ibid., 3.
[126] Geis and Hailes, *Deterring Emergent Technologies*, 50.
[127] Marchant and Wallach, *Coordinating Technology Governance*, 6-7.

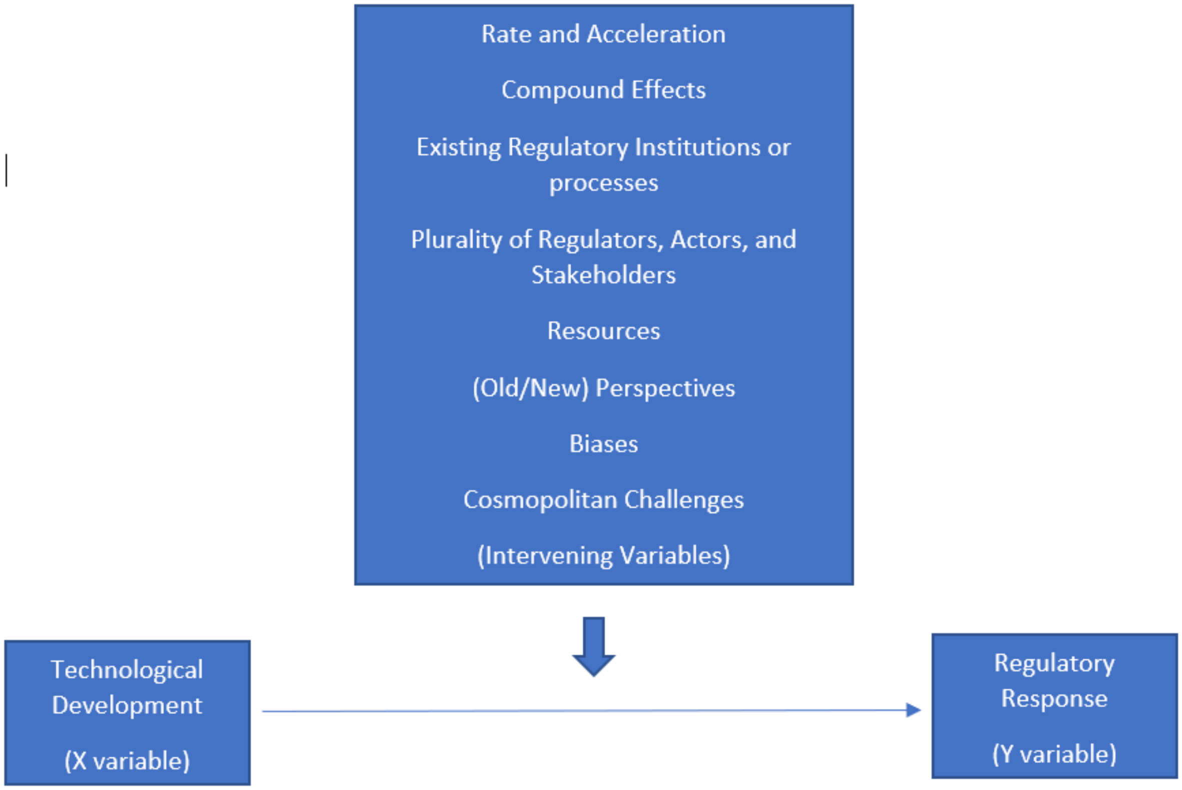

Figure 3, Conceptual Model (with X being the independent variable and Y the dependent variable)

2.4 Clarke and Moses' tools and criteria for assessing regulatory responses to COTS-UASs

Whereas Brownsword highlights the general challenges and opportunities associated with regulating new technologies, Clarke and Moses focus specifically on drones, regulations, and public safety. This thesis uses Clarke and Moses' tools for evaluating connectedness and their criteria for assessing effectiveness in ensuring public safety.

From Brownsword's theory, Clarke and Moses adopt the need for "constant 'reconnection'" between regulation and apply it to the subject of drones.[128] Clarke and Moses do so because, in their opinion, there is there is a potential for a "void with very little control over particular conduct" between regulations and drones.[129] Assessing how the Dutch regulatory response has ensured public safety can thus serve as a measure of how well regulators' efforts have stayed connected to the technological reality of COTS-UASs. The intervening variables, depicted above, are then what can hinder or complicate the process of staying connected and effective.

[128] Clarke and Moses, *Public Safety*, 267.
[129] Ibid.

2.4.1 Tools used to assess connectedness

The following points from Clarke and Moses, are used as tools with which to assess "the fit between an existing regulatory regime and new forms of conduct".[130] To assess connectedness this thesis will need to determine whether the following occurred:

1. The need for special rules to deal with a new situation
2. Uncertainty as to how the law applies to new forms of conduct, in particular:
(a) uncertainty as to how a new activity, entity, or relationship will be classified
(b) uncertainty where a new activity, entity, or relationship fits into more than one category, so as to become subject to different, conflicting rules
(c) uncertainty in the context of conflicts of laws
(d) uncertainty where an existing category becomes ambiguous in light of new forms of conduct
3. Over-inclusiveness and under-inclusiveness (also described as problems of targeting in new contexts)
4. Obsolescence, where:
(a) conduct regulated by an existing law is no longer important
(b) a rule can no longer be justified
(c) a rule is no longer cost-effective.[131]

Assessing connectedness in the Netherlands between 2015 and 2018 will involve determining if (1) new rules were necessary, if (2) uncertainty occurred in the regulatory regime, and whether (3) over-and-under-inclusiveness or (4) obsolescence occurred in the Dutch regulatory response.

2.4.2 Evaluation criteria for assessing the effectiveness of COTS-UAS regulatory regimes

This research applies the criteria listed below in Table 1 as a means of evaluating the effectiveness of the Dutch regulatory responses. These criteria also reflect the aforementioned challenges and solutions discussed by Marchant and Wallach. First, the *process* section entails considering information during, and involving actors and stakeholders in, the regulatory process. Second, the *product* section allows for an analysis of the regulatory framework implemented in the Netherlands. Third, the focus of the *outcomes* section exhibits some similarities with the issue of deterring unwanted behavior involving COTS-UASs.

TABLE 01: Effectiveness Evaluation Criteria: Recreation of the table from Clarke and Moses: " Criteria for the evaluation of a regulatory regime".[132]

Criteria for the evaluation of a regulatory regime.
Process • **Clarity of Aims and Requirements** Purposes and obligations are understandable by the parties that are subject to regulations (the regulatees) and to the intended beneficiaries of the regulation • **Transparency** Development of review processes are open, and requirements are published • **Participation**

[130] Ibid.
[131] Ibid.
[132] Ibid., 268. Note: For clarity, the information within the table is consistent with the one made by Clarke and Moses. It was not copied directly for sake of formatting issues as taking a screen capture would result in less readability.

All stakeholders are involved and/or represented in development and review processes • **Reflection of Stakeholder interests** The needs of beneficiaries are addressed and the legitimate interests of regulatees reflected
Product • **Comprehensiveness** All relevant aspects are encompassed within a coherent framework • **Parsimony** The regime is no more onerous or expensive than is justified • **Articulation** The requirements are sufficiently specific and operationalized to enable effective and efficient implementation by regulatees • **Educative Value** Requirements are expressed in explanatory and instructive from, rather than in abstract, discursive prose • **Appropriate Generality and Specificity** The scope and the requirements are sufficiently general to cover at least reasonable future developments, but sufficiently specific to avoid over-inclusiveness and anomalies
Outcomes • **Oversight** Regulated behaviors are subject to monitoring • **Enforceability** Regulated behaviours are subject to enforcement actions, by beneficiaries directly, and by an enforcement agency • **Enforcement** The enforcement agency has appropriate powers and resources, and uses them in order to achieve compliance • **Review** The scheme is reviewed and adapted to ensure that the outcomes correspond to the aims.

First, these criteria are relevant because they were designed with the technology of COTS-UAS in mind; second, because formulating regulations on COTS-UASs comes with its own specific safety challenges; and, third, the fulfillment of these criteria allows regulations to counteract safety issues associated with COTS-UAS.[133] These criteria can thus serve as a measure of a regulation's effectiveness.

The table refers to transparency as open access to information regarding the regulatory process. However, for the purposes of this research, *transparency* as a concept means the extent to which COTS-UASs can be detected, identified, and attributed to operators during flight. The concept of transparency adopted in this thesis is explained in greater detail in a subsequent section.

Assessing the connectedness and effectiveness of the Dutch regulatory response through these criteria is done for three reasons: first, the multiple parties interested in the governance of COTS-UAS; second, the threat of increasing rates of technological development outpacing societal responses; and, third, the fact that regulatory responses might be slowing down due to the increasing number of parties involved in the governance process.

2.5 COTS-UASs and public safety issues

To understand how the need for oversight, enforceability, enforcement, and review relates to the issue of ensuring public safety with COTS-UASs knowledge of the following safety concerns is important. More specifically, the aspects of oversight, enforceability, enforcement, and review can be applied to the following problem: Detecting or deterring unwanted behavior involving COTS-UASs is

[133] Clarke and Moses, *Public Safety*, 282.

difficult and expensive, whereas it is *cheap and easy* for people to transgress the rules the rules governing COTS-UASs.

2.5.1 Safety: a balance between cheap and easy and difficult and expensive

First, COTS-UASs present safety issues to both those on the ground and other air traffic during take-off, flight, and landing because what goes up must come down, either intentionally or by accident.[134] The following aspects distinguish the safety issues associated with COTS-UASs from those associated with manned aviation.

Compared to manned aviation aircraft, COTS-UAS are significantly more affordable. However, this is partly due to "the limited extent to which safety-related features are included".[135] Therefore, the affordability of COTS-UAS comes at the cost of reliability and redundancy features that act as safeguards against accidents in manned aviation. Although higher-quality COTS-UASs include additional safety or redundancy measures, this is not a regulatory requirement. Affordability at the cost of redundancy or reliability in turn lowers the monetary threshold for people to use COTS-UAS.[136]

Beyond a lack of aforementioned redundancy features, there is also the issue of "low standards of hardware and software quality assurance".[137] These issues with hardware and software assurance occur because, at the time of writing, there are no regulations that enforce quality control or production standards for COTS-UASs sold in the Netherlands. In the meantime then, the Dutch HETI certifies the technical quality of individual drones used by the professional sector.

2.5.2 The issue of attributing the acts conducted with a COTS-UAS to the direct user of that COTS-UAS.

The central issue is that, while it can be straightforward and cheap to fly COTS-UASs, there are "high costs involved in detection, investigation, and sheeting home responsibility".[138] The term *sheeting* requires explanation. What is meant by this term is that there is a need to be able to attribute the responsibility for certain acts involving COTS-UASs.[139] This topic is discussed later in this thesis alongside the concept of "attribution" from Geis and Hailes' deterrence theory; for now, it suffices to state that the issue is that it is *easy and cheap* to use COTS-UASs, while the process of detecting, investigating, and holding people responsible for transgressions involving COTS-UASs is *difficult and expensive*.[140]

Without regulations enabling insight into and enforcement of the rules governing the use of COTS-UASs, there is little to deter people from engaging in unsafe acts, as their chances of being caught red-handed or punished after the fact are slim. The opportunity for regulation is then to attempt to balance the *cheap and easy* versus *difficult and expensive* dilemma by, for example, making COTS-UASs more detectable, thus resulting in a greater likelihood of punishing transgressors.

Whereas Clarke and Moses, refer to the ability of identifying the direct user of a COTS-UASs as *sheeting responsibility*, Geis and Hailes refer to linking the use of a technology to an actor as

[134] Clarke and Moses, *Public Safety*, 263.
[135] Ibid., 264.
[136] Ibid.
[137] Ibid.
[138] Ibid.
[139] Merriam-webster, *sheet*, verb 2.2.
[140] Geis and Hailes, *Deterring Emergent Technologies*, 59.

“attribution”.[141] Attributing acts involving undesirable use of COTS-UASs to the perpetrators is easier said than done, but this difficulty highlights a challenge in ensuring public safety, particularly in terms of the oversight, enforceability, and enforcement aspects of Clarke and Moses' table.

2.5.3 Airmanship

Regulations can also address safety issues by requiring a certain level of airmanship on the part of those who operate COTS-UAS. The term airmanship means having the appropriate skills, and knowledge of (and respect for) the relevant rules and regulations to fly safely. Therefore, in addition to the need to implement regulations concerning aircraft, all users of COTS-UASs should be encouraged to be aware of their responsibilities as pilots.

2.6 Theories related to security issues

2.6.1.1 Deterrence by denial

Another aspect of ensuring safety relates to deterrence by denial (DBD) of resources. The retired United States Air Force colonels John P. Geis II and Theodore C. Hailes discuss how deterrence theory applies to both existing threats and new ones that may arise due to the emergence of novel technologies .[142] Geis and Hailes argue that, as opposed to deterrence by fear of retribution (DFR), there are opportunities for “deterrence by denial”.[143] DFR was adopted by nations during the Cold War because denial of access to nuclear weapons was no longer an option between superpowers.[144]

Therefore, the focus should be on denying adversaries certain resources, as opposed to the threat of future punishments.[145] Deterrence through denial of resources is also important with regard to terrorist use of COTS-UASs, particularly in terms of investigating and limiting the supply networks that are used to transport such systems into conflict zones.[146]

In line with DBD, with emergent technologies “there are opportunities to prevent or protect from attacks, to thwart the goals of prospective adversaries, and to deter or hinder the developments of these capabilities in the first place”.[147] With regard to COTS-UASs, this means that that regulations could focus on making it more difficult and expensive to engage in undesirable behavior involving such systems and increase the likelihood that transgressors will be identified and apprehended in a timely manner.

Besides security issues, this research also argues that Geis and Hailes’ thoughts on DBD can be applied to COTS-UAS-related safety issues. Applying theory related to security issues does not mean that unsafe pilots are aggressors; instead, unsafe use of COTS-UASs can be deterred by making the detection and attribution of such drones cheaper and easier through regulation; in turn, this will make unsafe use of COTS-UASs more difficult and expensive.

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[141] Ibid.
[142] Ibid., 47.
[143] Ibid., 58.
[144] Ibid., 57.
[145] Intriligator, *Economics of Terrorism*, 5.
[146] Rassler, *The Islamic State Drones*, V, 24.
[147] Geis and Hailes, *Deterring Emergent Technologies*, 58.

2.6.1.2 The deterrence equation

The preceding discussion leads to Geis and Hailes' thoughts on the *deterrence equation*. It is important to note that the deterrence equation is built on two assumptions: attribution and that of rational actors. Meaning, that the equation assumes that the people to be deterred act rationally in their decision making and that their acts with a technology can be attributed to them.

The importance of being able to attribute an act committed with an emergent technology to the actor is that "Should attribution be problematic, it tilts both parts of the deterrence equation in favor of the potential aggressor".[148] This is because a lack of attribution makes it more likely that an act will succeed, as the actor is less likely to be caught in the act and unlikely to be punished after the fact.[149] The second assumption, specifically that terrorists are also rational actors as opposed to "madmen," is also important from a CTS perspective.[150]

Geis and Hailes visually depict the following observation by John Mearsheimer "the failure of deterrence is specified as a calculus in the mind of the actor to be deterred"....through their "deterrence equation," which is presented in Figure 4, below.[151]

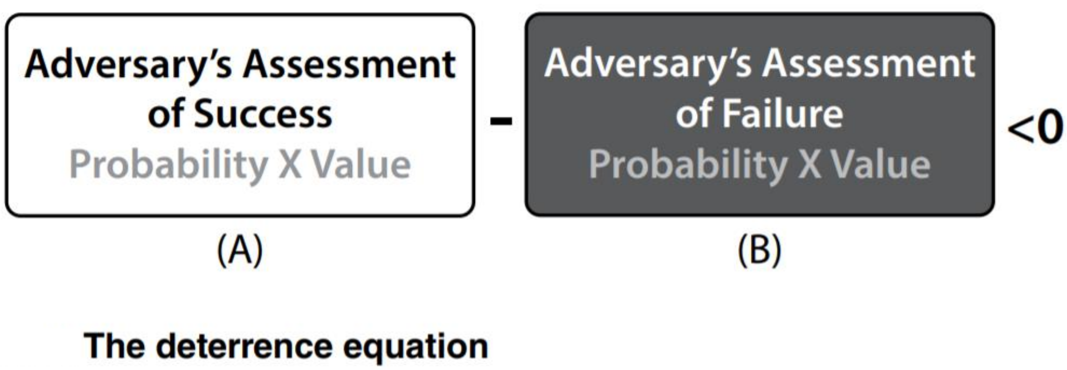

Figure 4, The deterrence equation.[152]

Keep in mind, unwanted acts with COTS-UASs includes direct striking of targets but also trafficking illicit goods or stealing data. If one sees those conducting these unwanted acts as adversaries the following can be said on the effect of deterrence on that person. Mearsheimer considers an adversary's assessment of the likelihood of success to be a product of "the gain to be incurred by attacking" and "the probability that the attack will succeed".[153] Therefore, both the chance of succeeding and the expected value of succeeding is taken into account.

An adversary's assessment of failure consists of their chance of failing multiplied by the value lost (therefore cost) in failing. When both *assessments* are compared, an adversary will only deterred

[148] Ibid., 59.
[149] Ibid.
[150] Qtd in. Jackson et al., *Terrorism*, 22.
[151] Geis and Hailes, *Deterring Emergent Technologies*, 58.
[152] Ibid., 59.
[153] qtd. Geis and Hailes, *Deterring Emergent Technologies*, 59.

should the value of B be greater than that of A,[154] meaning that the perceived likelihood and cost of failing is greater than the perceived likelihood and value of succeeding.

2.6.1.3 Transparency

Applying the deterrence equation requires one to consider the levels of transparency and immunization in a society. For Geis and Hailes, transparency allows for the timely identification of individuals who use a particular technology. Transparency consists of "(1) technical developments that aid in tracking people and objects through space and time, (2) ongoing innovation in this area, and (3) the advent of new command-and-control concepts".[155] If hostile actors believe that their actions will be highly discoverable and attributable to them, these actions will likely be deterred.[156] Transparency can then be understood as referring to measures that increase real-time insight into both COTS-UASs and their operators, meaning that COTS-UASs can be detected and attributed directly to their direct user.

To allow for better transparency, the attribution problem has to solved. The attribution problem lies in connecting the acts of individuals to the technology used. Therefore, this thesis' assessment of the Dutch regulatory response considers how the Netherlands approached the attribution problem.

First, regulation can increase transparency by requiring certain features to be installed in COTS-UASs that aid in detecting, identifying, tracking, and a craft and attributing it to its owner. Second, regulators can increase transparency by developing both physical and non-physical (i.e., data) infrastructure related to COTS-UAS operations. Such an approach requires physical equipment for detecting, identifying, and tracking COT-UASs and maintaining up-to-date and accessible databases in order to enable enforcement of the rules. When adopting such an approach, technological developments can be helpful in increasing transparency.[157]

Increased transparency can also aid in promoting the public acceptance of COTS-UASs due to the misuse of such systems becoming less likely; that is, if transparency is high, the public is likely to be more trusting of UASs, as they will know that such systems are subject to monitoring and that unwanted acts are likely to be punished. Regulations that foster transparency can then ensure smoother integration of the technology, along with its beneficial effects, into Dutch society, as increased transparency will likely deter people from using COTS-UASs in illegal and/or unsafe ways.

2.6.1.4 Immunization

Whereas transparency revolves around "knowledge rather than control," immunization is intended to "deny success".[158] Immunization, for Geis and Hailes, ensures that potential attacks are less effective.[159] Immunization can be increased by, for example, enhancing the resilience of infrastructure against attacks or employing countermeasures.[160] Increasing deterrence by immunization tilts the equation back in favor of the defender because the impact (and thus the value) of an attack or event will be minimized. As a result, wrongdoers will find it harder to successfully commit criminal acts, while the value of a successful attack will be reduced. There is thus an opportunity for regulation to demand the

[154] Geis and Hailes, *Deterring Emergent Technologies*, 59.
[155] Ibid., 64.
[156] Ibid., 65.
[157] Ibid., 64.
[158] Ibid., 65, 66.
[159] Ibid.
[160] Ibid.

inclusion of security-by-design features that can aid in immunization against unwanted uses of COTS-UASs.

Immunization also means increasing the "cognitive resilience" in a society.[161] As noted in Chapter 1, the framing of COT-UASs can negatively influence public opinion regarding such systems. In addition, the manner in which COT-UASs are portrayed can influence terrorists to use such systems in order to secure media attention. In countering the attraction of COTS-UASs to terrorists, immunization has the potential to ensure "a mind-set in which, even if an attack occurs, there is not a disproportionate psychological reaction to the strike".[162] The better informed that members of the public are about an emergent technology, the more resilient they will be against acts intended to cause panic or sway public opinion.

Immunization can also occur against safety issues. This is can be done by increasing the reliability of COTS-UASs. Addressing the previously mentioned lack of built-in redundancy features in COTS-UAS would be one way of increasing resilience against the safety issue of crashes due to technical failure. Safety-by-design and other forms of immunization can also decrease the likelihood of an accident and minimize the impact of any accident that does occur.

An example of security by design stems from an anecdote concerning the use of a UAS to vaccinate large animals. This UAS was designed in such a manner that it had to embed itself into its target, as opposed to be able to inject a vaccine into an animal from afar.[163] This design made it more difficult to deploy substances other than vaccines using this drone, for other purposes, through the entire design of the UAS. Regulation can increase security exist through the inclusion of specific features into COTS-UASs and the manner in which they are brought to the market.

2.6.1.5 How the technological development of COTS-UASs influences the deterrence equation

The link between the development of drones and terrorists has been described as follows:

> The broad proliferation of drones, and the simultaneous downsizing of platforms and the enhancing of their capabilities and add-on features, makes them only more attractive and financially and logistically more accessible.[164]

Developments such as those mentioned above can reduce the ability to deter unwanted uses of COTS-UASs because difficulties in attribution make the success of such acts more likely, just as it makes failure less likely. COTS-UASs have developed to such a level that they offer capabilities similar to those of lower-end military craft at a fraction of the cost.[165] To further elaborate on how security issues can be addressed, the focus now shifts to concepts from the field of CTS.

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[161] Ibid.
[162] Ibid.
[163] Mommers, *Masterwork Transcription Document*, 9.
[164] Rassler, *Remotely Piloted Innovation*, 63.
[165] Velicovich, *Consumer Drone*.

2.6.2 Security: crime and terrorism

2.6.2.1 Terminology concerning terrorism.

In *Terrorism: A Critical Introduction*, Richard Jackson et al. state that "no universally accepted definition of terrorism has been produced by scholars or political elites".[166] Jackson et al. argue for a "movement from definition to description".[167] However, this does not mean one has to reject the different perspectives on terrorism; rather, one should "abandon the quest for an objective scholarly definition".[168] Critical terrorism studies views terrorism not as an objective concept but as a "social construction" that is given meaning through social, political, legal, and even academic processes and language.[169] It is thus important to recognize the intent of researchers and how they view terrorism as opposed to claiming the existence of an objective and neutral definition.[170]

Therefore, this research adopts a definition of terrorism that is useful in terms of its research objective, as opposed to an objective definition that would be usable in other studies.[171] This approach makes it possible to adopt a particular definition of terrorism while acknowledging that others exist. For this research, the following definition, which is used by the Netherlands' own institutions, from The National Coordinator for Security and Counterterrorism (NCTV) was chosen:

> Terrorism is defined as threatening, making preparations for or perpetrating, for ideological reasons, acts of serious violence directed at people or other acts intended to cause property damage that could spark social disruption, for the purpose of bringing about social change, creating a climate of fear among the general public, or influencing political decision-making.[172]

The NCTV of the Dutch MiJS uses this description throughout those sections of the organization engaged in counterterrorism.[173] Because this research considers terrorism within the context of the Netherlands, using a Dutch definition fits the intent and purpose of this thesis.[174] Furthermore, the NCTV's definition of terrorism incorporates the following characteristics, which are important to a critical perspective on terrorism.

The first point to note concerning this definition is that CTS describes terrorism as "politically motivated violence" meant to send a message to a person, group, or society and that it is "a means to an end, not an end in itself".[175] The NCTV's description also includes this recognition of terrorism as tool in pursuit of other political goals besides the violence itself. The issue of instrumentality (the idea that terrorism pursues a purpose beyond the death of its victims) was previously discussed in Chapter 1.[176] Furthermore, the NCTV's definition does not exclude state-based, or state-sponsored, forms of

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[166] Jackson et al., *Terrorism*,108.
[167] Ibid., 115.
[168] Ibid.
[169] Ibid., 3.
[170] Ibid., 115.
[171] Ibid., 109-110, 115.
[172] National Coordinator for Security and Counterterrorism, *To Counter Terrorism*.
[173] Ibid.
[174] Jackson et al., *Terrorism*, 115.
[175] Ibid., 116-117.
[176] Ibid., 118.

terrorism, which are arguably far more severe, nor does it attribute terrorism to a *particular* ideology.[177] However, given its scope, this research only focuses on non-state forms of terrorism by means of COTS-UASs.

This approach allows the research to consider terrorist uses of COTS-UASs in a critical manner. This research, however, does not just consider how COTS-UASs can be used by specific parties for purposes involving direct violence, such as the delivery of dangerous payloads. Instead it views COTS-UASs as a resource that can be employed for many other, possibly more useful, purposes than delivering payloads.

Not just focusing on the delivery of dangerous payloads is important given that the surveillance capabilities that COTS-UASs offer non-state actors are more of a novel development than the aerial delivery of payloads with remote controlled aircraft. This research thus considers terrorist use of COTS-UASs in terms of the use of specific resources in pursuit of the intentions identified in the NCTV's definition, which can be deterred by means of denial.[178] Finally, acknowledging the *displacement effect* – which is discussed in the following subsection – contributes to arguments in favor of deterrence by denial of resources**.**

2.6.2.2 The terrorist use of COTS-UAS and the displacement effect

On the motivations for terrorists' use of drones, Intriligator states that "Terrorists will likely be using the path of least resistance".[179] Intriligator's statement implies that, should a certain target be adequately protected, terrorists will simply select another target.[180] Therefore, it is more difficult to protect all possible targets against terrorist attacks than to adopt the preferable approach of "denying resources to the terrorists".[181] This view with regard to target selection is supported by Jackson et al., as, when countermeasures are employed one point, this can cause a "displacement effect" of attacks to other, less protected locations.[182]

2.6.2.3 The framing of terrorism and counterterrorism approaches to non-state terrorism in critical terrorism studies

2.6.2.3.1 Force-based responses

The force-based approach to countering terrorism relies on a state's military means to "destroy, disrupt, deter, or prevent future acts of terrorism".[183] This approach "is based on a view of terrorism as a special form of warfare and relies largely on the military as the primary counter-terrorism actor".[184] Unfortunately, this can result in potentially ineffective force-based responses to terrorism intended to increase security:

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[177] Ibid., 194.
[178] Rassler, *The Islamic State Drones*, V, 24.
[179] Intriligator, *Economics of Terrorism*,12.
[180] Ibid.
[181] Ibid*.,* 5.
[182] Jackson et al., *Terrorism*, 233.
[183] Ibid., 225.
[184] Ibid., 226.

> Countering the perceived threat of terrorism has resulted in the investment of hundreds of billions of dollars in new institutions, programmes, and policies that are extremely lucrative and beneficial to key actors and sectors like the military-industrial complex, private security providers and state security institutions . . .being of dubious effectiveness in preventing terrorism.[185]

Framing terrorism as a form of extraordinary violence can result in similarly extraordinary countermeasures. However, the issue is not simply that force-based approaches may be ineffective, as such approaches can actually be "counter-productive, particular in comparison to conciliation-based approaches".[186] In contrast, the conciliation and dialogue (C&D) approach, which is described in the following section, can address the causes of terrorism without resorting to violence.[187]

2.6.2.3.2 Conciliation and dialogue

The C&D approach aims to discourage actors from opting for terrorism altogether by resolving underlying issues.[188] The C&D approach views "terrorism as the expression of socio-political grievances and conflicts".[189] The C&D approach has clear merits, especially when compared to the force-based approach, because the latter can give rise to further grievances or other factors that can encourage actors to engage in terrorism.[190] However, should it be impossible to achieve conciliation, or even dialogue, or should such an approach not even be attempted, other approaches will have to be adopted to address security threats. Given the scope of this thesis, it does not address C&D approaches in detail However, C&D not being the main focus does not detract from the merits of C&D as a counterterrorism approach, nor does this thesis argue that the C&D approach should not be applied. The C&D approach remains valuable because it aims to address the factors that cause terrorism in the first place, rather than addressing its symptoms. This thesis is focused on the use the resource of COTS-UASs by terrorists and what can be done to deter such unwanted use of a promising emergent technology. However, if the results of this research point to the effectiveness of C&D approaches, specific to COTS-UASs, this can still be included.

2.6.2.3.3 Intelligence and policing

Besides the force-based approach and C&D there are two other approaches to counter terrorism that can prove particularly of use with COTS-UAS. First, COTS-UASs may be well-suited to the approach known as intelligence and policing (I&P), as this strategy focuses on identifying the resources used by terrorists and denying them.[191] Second, the I&P approach features many of the characteristics that Geis and Hailes indicate as being useful in terms of increasing transparency in their deterrence equation. Transparency focuses on gaining insight into the use of specific technologies, whereas the I&P approach aims to obtain insight into people who would threaten security regardless of the technology used.

I&P's focus on identifying security threats regardless of the type of threat comes from the following idea central to the I&P approach: "The intelligence and policing approach is based on a view of terrorism as a serious security threat to the state, but which is nonetheless primarily a form of criminal

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[185] Ibid., 244.
[186] Ibid., 232.
[187] Ibid., 227.
[188] Ibid.
[189] Ibid., 225.
[190] Ibid., 232.
[191] Ibid., 226)

activity rather than warfare".[192] This means that combating terrorism does not necessarily call for measures other than those already employed against criminal activity. An excellent example of I&P would be the policing efforts that prevented a terrorist attack in the Netherlands in September of 2018 by performing arrests before a planned attack could take place.[193]

Therefore, the greatest security benefits may result from strengthening existing intelligence networks and surveillance efforts. Specifically, the focus should be on the timely identification and interception of potential security threats, regardless of the technology involved. In other words, threats should be identified and addressed before, in this case terrorists, can put resources to use.

2.6.2.3.4 Homeland security

Another counterterrorism approach mentioned by Jackson et al. is that of homeland security (HS).[194] The HS approach involves increasing the amount of available responses to terrorist attacks and overall societal resilience by implementing countermeasures and relying on a nation's security organizations, as well as protecting critical infrastructure.[195]

When compared to the HS approach the I&P approach may prove a better option in terms of addressing security issues for the following reasons: first, due to the displacement effect, terrorists may prefer to strike more vulnerable targets. Second, the I&P approach focuses on investing in measures to counter terrorism just as it would other criminal activities. This means less investment and efforts to create separate or additional institutions to counter terrorism. Third, I&P focuses on the identification and prevention of security threats, whereas HS emphasizes responses to and resilience against threats that do occur. The I&P approach attempts to counter security threats before they can occur and therefore any I&P efforts to counter terrorism are therefore less affected by the displacement effect.

Therefore, this research investigates how Dutch regulators viewed the threat of terrorists using COTS-UASs, what approach they took to countering it, and what influenced their viewpoint and subsequent decisions. Thus, the issue of terrorism through use of COTS-UASs, as well as what can be done about it, must be discussed without overemphasizing either the threat itself or force-based countermeasures.

2.7.1 Applying the discussed theories on S&S issues to the Dutch case

For research to be effective, the selected theories should allow engagement with and understanding of the research subject.[196] This means that the selected theories must enable an understanding of the processes underlying the Dutch response to COTS-UASs proliferation.

How this thesis achieves a way of understanding the subject matter can be visualized as such:

[192] Ibid.
[193] Landelijke Eenheid Politie, *Zeven Aanhoudingen*.
[194] Jackson et al., *Terrorism,* 226.
[195] Ibid., 226
[196] Verschuren and Doorewaard, *Designing a Research Project*, 69.

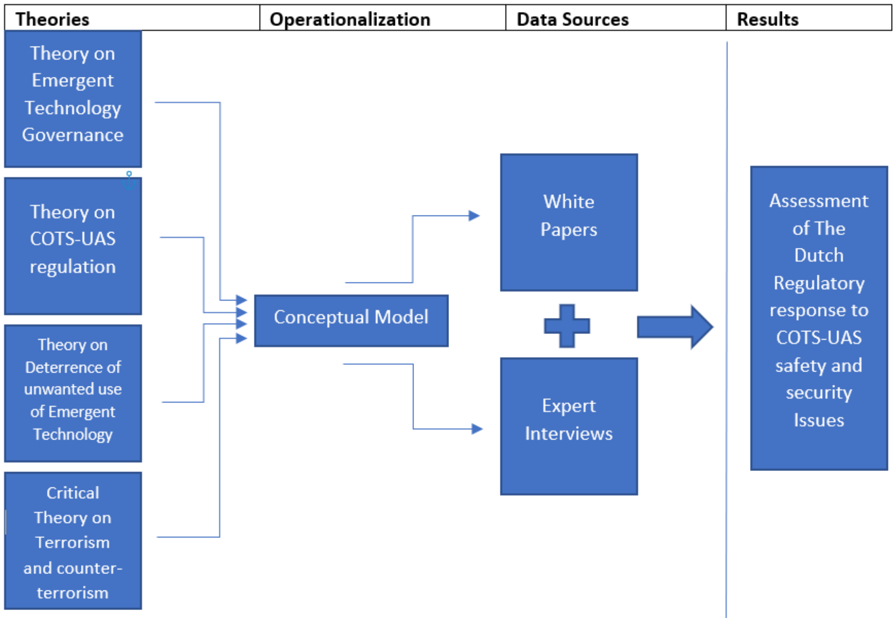

Figure 5, visual representation of the research, its theories, and data sources.[197]

Analyzing different aspects of the Dutch regulatory response requires different theories, as understanding this nation's response involves understanding different processes in relation to each other. These processes range from the challenges and solutions associated with the governance of emergent technology to deterring unsafe and/or dangerous behaviors involving COTS-UASs.

2.7.2 How this research interprets these theories in order to fulfill its research objective

First, this thesis applies theory on the governance of emergent technology and the issue of regulatory connection. Second, this research uses theory on assessing the connectedness and effectiveness of regulation specific to UAS and safety issues. Third, security issues can be understood through deterrence theory and the field of CTS and allow for the assessment of possible gaps between COTS-UAS-related security issues and Dutch security policy.

In terms of security, this means determining whether security issues related to COTS-UASs were deterred through fostering transparency and/or immunization. As discussed, increasing transparency or immunization relies on solving the attribution problem. Furthermore, this research considers whether regulators selected I&P or HS approaches in deterring and countering potential terrorist use of COTS-UASs. This means that force-based (military) responses and C&D are not the focus of this research. However, should these approaches be found to be of particular relevance to the Dutch case, they will be included in the results.

The I&P approach can be seen as focusing on increasing transparency and attribution with regard to terrorism regardless of the resources used. In contrast, HS efforts focus on increasing societal resilience and the available responses to security threats specifically. In this way, the I&P and HS approaches can also influence the deterrence equation. Regulatory measures such as those mentioned in Chapter 1 can increase immunization through security-by-design features and aim to prevent harm from being able to occur in the first place. On the other hand, should such acts not be deterred by

[197] Ibid., 70.

regulatory countermeasures, both I&P and HS efforts can still result in the interception or neutralization of threats either by apprehending actors or by taking down hostile COTS-UASs via either passive and/or active countermeasures.

The implementation of passive and active countermeasures can then be seen as a form of HS and as a response to hostile acts. The takeaway message is that HS focuses specifically on increasing specific means and resilience in order to address terrorism. Active and passive Countermeasures developed with COTS-UASs in mind thus fall under HS, whereas security-by-design features are forms of immunization against security issues through regulation.

2.8 Propositions and hypotheses

2.8.1 Propositions

Babbie defines propositions as "specific conclusions, derived from the axiomatic groundwork, about the relationships among concepts".[198] Based on works of academics focused on technological developments and societal responses, the following propositions were formulated at the start of this research:

Response gaps between emergent technologies and regulations can occur due to the following:
1. An emergent technology developing compound effects with other (emergent) technologies;
2. An increase in the rate of technological changes (more individual changes are occurring, frequency);
3. Acceleration of the pace of technological change (each individual change occurs faster, speed);
4. Dated perspectives or biases, such as cultural or institutional tendencies, that prevent adequate responses from being developed;
5. An inability to develop a response due to a lack of time, financial means, people, or other constraints on resources; and
6. A plurality of regulators, actors, and stakeholders (or cosmopolitan challenges) making timely responses more difficult.

These propositions led to the formulation of the hypotheses investigated in this research, which are presented below

2.8.2 Hypotheses

The formulation of a hypothesis involves "Disconfirmability, or the possibility of falsification".[199] Based on the formulated propositions and an initial review of the situation in the Netherlands, the following main hypothesis is formulated:

1. A response gap between Dutch regulations and emergence of COTS-UASs occurred due to the *rate and acceleration* at which said technology evolved.

The alternative hypotheses to the main hypothesis are as follows:

2. A response gap occurred due to obstacles within the regulatory process, such as the organizational structure of the ministries.
3. A response gap occurred due to resource constraints in terms of time, people, finances, and/or materials.

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[198] Babbie, *The Practice of Social Research*, 70.
[199] Ibid., 72.

The Rival hypotheses to the main hypothesis are as follows:

4. Safety and security issues were not identified in time, which prevented a proportionate regulatory response.
5. There were/are no longer any, response gaps between the regulatory response of the Netherlands to the emergent technology of COTS-UASs and the development of such drones.

The above propositions and hypotheses led to the formulation of the following sub-questions intended to feed into answering the MRQs.

2.8.3 Main research questions:

First, is there a response gap between the technological development of COTS-UASs and the regulatory response of the Netherlands in terms of safety and security issues?

Second, if a response gap is found, how can this gap be explained?

Sub-questions:

The following sub-questions were formulated with regard to safety:

How did the technological development of COTS-UASs complicate or challenge the Dutch regulatory response?

How do the current regulatory measures for COTS-UASs deal with safety issues in order to integrate this technology into Dutch society?

What influenced Dutch regulators in their decisions concerning COTS-UASs?

What regulatory measures aid (or could aid) in ensuring that Dutch society benefits from the advantages offered by the adoption of this technology?

These questions were formulated with regard to security:

How can regulations aid in protecting against COTS-UAS-related security issues?

How does the technological development of COTS-UASs increase the capacity of criminals and terrorists?

Is there a bias on the part of either actors or researchers towards viewing COTS-UAS technology from a perspective that focuses on terrorism, and, if so, does this bias influence the regulatory response?

How can the Netherlands use or regulate COTS-UASs to ensure its own security?

What forms of countermeasures are useful in countering unwanted behavior involving COTS-UASs in the Netherlands?

These questions provide room to investigate all factors previously identified as intervening variables. For example, cosmopolitan challenges might have occurred in terms of available resources or because of a plurality in terms of regulators, actors, and stakeholders occurring on a European level. Therefore, rather than being addressed under their own questions, any cosmopolitan challenges identified will be addressed under the questions that they relate to the most. However, the manner in which such questions will ultimately be addressed depends on what is found during the results.

To conclude, the causal links identified in this chapter mean investigating how the data reflects the connectedness and effectiveness of the Dutch regulatory response. Furthermore, determining if the Dutch response focused on measures of transparency and/or immunization with regard to the deterrence of unwanted behavior involving COTS-UASs. Second, it involves determining whether I&P or HS approaches were implemented to counter COTS-UAS-related security issues. These approaches, when considered alongside the challenges and solutions relevant to the governance of emergent technology, allow for an analysis of the Dutch regulatory response.

Chapter 3: Methodology

This chapter presents the research methods and the methods of data collection and analysis chosen for this thesis. In addition, this chapter demonstrates how good research conduct, accurate results, and internal and external validity were assured.

3.1.1 The choice of a qualitative case study

The nature of this research is explanatory, meaning that it intends to provide causal explanations as to what did, or did not, occur with regard to the Dutch regulatory response to COTS-UASs.[200] In researching this topic, a qualitative approach allows for the use of information, that is "richer in meaning" than quantitative data.[201] The sources of information considered for this research are Dutch government documents on the topic of COTS-UASs (white papers) and qualitative interviews.

In a case study, a qualitative approach can also increase the acceptance of the research results by people in the relevant field, while an in-depth approach allows for a clear and extensive discussion of the research subject.[202] Given the number of Dutch regulators, actors, and stakeholders involved in the subject matter, acceptance by these parties is important in terms of the usefulness and credibility of this research.

The frequency at which qualitative case studies are conducted in the social sciences also made a case study an obvious choice.[203] The author was advised to consult the work of Robert K. Yin titled *Case Study Research: Design and Methods*, which enjoys widespread use throughout academia.[204] Additional guidance in conducting the case study was provided by Babbie's *The Practice of Social Research* and Verschuren and Doorewaard's *Designing a Research Project*. A case study was determined to be the most appropriate method due to the type of questions posed in this research, the subject matter at hand, and the time frame in which the events being investigated took place.[205] The following paragraphs support the choice to conduct a qualitative single-case study.

3.1.2 The advantage of qualitative methods allowing qualitative interviews

In addition to qualitative analysis of documents, a case study allowed the use of qualitative interviews. Conducting a case study that includes qualitative interviews offered two advantages: First, it allowed for the inclusion of the multiple parties identified as being important to the research subject in Chapter 2. Second, it allowed these parties to communicate their insights and knowledge directly to the researcher. Therefore, besides being common in case studies, qualitative interviews were also considered the best tool for obtaining the most relevant and useful data for this research.[206] Furthermore, interviews also allowed for more detailed insights into the Dutch regulatory response. A case study approach allowed experts on both safety- and security-related topics to contribute their experiences with COTS-UASs to this research.

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[200] Ibid., 17.
[201] Ibid., 25.
[202] Verschuren and Doorewaard, *Designing a Research Project*, 156, 185.
[203] Ibid., 159.
[204] Yin, *Case Study Research*, 4.
[205] Verschuren and Doorewaard, *Designing a Research Project*, 178.
[206] Yin, *Case Study Research*, 110.

However, it was specifically mentioned during the course *Preparing the Master's Thesis* that organizations are generally hesitant to communicate their challenges or concerns to outside parties. This problem was offset by conducting confidential interviews. When assuring confidentiality, "the researcher can identify a given person's responses but promises not to do so publicly".[207] Therefore, the interviewees were all given the options to have their identity be confidential and to personally check their interview transcriptions before these were incorporated into the research. This approach allowed for the inclusion of information provided directly by regulators, stakeholders, and actors. Such information can be richer in meaning than that obtained through quantitative methods (or, indeed, it may not have been possible to obtain such information through quantitative methods). Given the number and variety of experts who participated in the research, this approach proved highly effective.

3.1.3 The choice of a single-case study

The Dutch regulatory response has been iterated upon, been in effect for years, and has had real-world consequences. This allows research into the influences and effects of Dutch regulations concerning COTS-UASs. Analyzing the European response as a single case would have been too complex due to both European regulations still being formulated at the start of this research and the multiple national-level regulations of the EU's member states. Therefore, the European regulatory response could not be analyzed as clearly as that of the Netherlands. In addition, a multiple-case study of several European countries was not possible due to time and resource constraints. To conclude, limiting the scope to the Netherlands allowed for an in-depth, yet still achievable, case study. Furthermore, a single-case study may prove helpful to future researchers intending to perform multiple-case studies.[208]

3.1.4 Why other methods were disqualified for use in this research

Table 2, listed below, is used to explain why a case study was the most appropriate social science research method for the subject at hand. Being aware of the research objective and main research question presented in Chapter 1 are critical to understanding the table. The following paragraphs clarify why other forms of research were less suitable for fulfilling the research objective. The primary difficulty was that the research objective involves determining why a response gap occurred should such a gap exist.

[207] Babbie, *The Practice of Social Research*, 36.
[208] Yin, *Case Study Research*, 150.

TABLE 02, Figure 1.2 from Yin.[209]

Method	**(1) Form of Research Question**	**(2) Requires Control of Behavioral Events?**	**(3) Focuses on Contemporary Events?**
Experiment	How, why?	Yes	Yes
Survey	Who, what, where, how many, how much?	No	Yes
Archival Analysis	Who, what, where, how many, how much?	No	Yes/no
History	How, why?	No	No
Case Study	How, why?	No	Yes

The first reason for the choice of a case study is that the entire process of the Dutch regulatory response to COTS-UASs was completely outside of the researcher's control. Therefore, the case study method was deemed appropriate due to this research's focus on recent events in which "the relevant behaviors cannot be manipulated".[210] Similarly, the possibility of conducting an experiment was disqualified because the required control on the behavior subject to research was not possible.

Second, a case study (as opposed to a survey) was also considered to be better suited to dealing with the surrounding context of the topic being researched.[211] This is because a case study can include outside influences on the Dutch response by consulting multiple sources of information to obtain more accurate results.[212] In addition, conducting a history may have been a good fit for the questions investigated in this thesis but would have required addressing a different time frame. This research needed to consider the recent years in which COTS-UASs proliferated and those in which Dutch regulators formulated their responses. Finally, due to this time frame, other data sources were required data than data sources that would make a history the most suitable research method.[213]

Third, the type of research questions (presented in Chapter 2) differs from those that would characterize a survey or an archival analysis. Given the requirements of the methods discussed above, they were not considered suitable for answering the research questions. Having discussed why other methods were considered less suitable for this research, it can be argued further why a case study was the *best* choice.

3.1.5 The suitability of the case study method

This research investigated *how* and *why* certain outcomes resulted during the formulation of the Dutch regulatory response to COTS-UASs. This study was an embedded case study because the effect of regulation on S&S issues involves two different units of analysis within the Dutch case. [214] Chapters 1 and

[209] Yin, *Case Study Research*, 9. Yin's table is reproduced here for sake of formatting and readability, and it was sourced by Yin from COSMOS Corporation.
[210] Ibid., 12.
[211] Ibid., 16.
[212] Ibid., 16-17.
[213] Ibid., 12.
[214] Ibid., 55.

2 make it clear that regulation can affect both safety and security by mandating that COTS-UASs include certain design features.

Clearly, this research would benefit most from data sources such as official documents from regulators discussing their response processes and actual interviews with relevant regulators, stakeholders, and actors. Fittingly, “the case study’s unique strength is its ability to deal with a full variety of evidence,” and the importance of including the multiple parties involved was addressed in Chapter 2. [215]

Furthermore, a case study allowed for the inclusion of the “contextual conditions” of the Netherlands, and these were expected to have had important influences on this nation’s regulatory processes.[216] The case study method also provided the flexibility required to address “rapidly changing” conditions, while the results obtained are more likely to make real-world contributions due to the researcher's close involvement with the subject matter.[217]

These advantages were all helpful in investigating the continuously developing technology of COTS-UASs and the relevant Dutch regulatory process. To conclude, it is clear that a case study was the most suitable method due to the kinds of questions that this research poses and the data collection methods that were required to answer these questions.[218]

3.2.1 Internal validity and the requirement of triangulation

To ensure internal validity, this research followed Yin’s procedures for conducting case study-based research. This meant following Yin’s case study protocol, as well as the creation of a case study database containing the collected data in the form of a masterwork transcription document (MTD) and a code book.[219] Adopting this approach ensured that the appropriate procedures were followed at the start of this research and during data selection, collection, and analysis. Following the steps proposed in Yin's work ensured that this research was conducted through established and vetted procedures.

The case study method, involves the following steps: First, a case study develops a research perspective, which is determined by engaging with debate and theory relevant to the research subject. [220] Second, it requires triangulation of data to support its claims.[221] This is also done to address the fact that, generally speaking, there is more information available than can realistically be transformed into “data points”.[222] Therefore, to ensure accurate results, a case study must select key theoretical findings to guide its research and multiple data sources.[223] Such an approach is particularly important in ensuring that a study can maintain focus on what is most important to the research subject and still produce clear results from a multitude of information.[224]

[215] Ibid., 12.
[216] Ibid., 16.
[217] Verschuren and Doorewaard, *Designing a Research Project*, 185.
[218] Yin, *Case Study Research*, 2.
[219] Ibid., 84-94.
[220] Ibid., 17.
[221] Ibid.
[222] Ibid.
[223] Ibid., 147.
[224] Ibid., 17.

In addition, triangulation was also necessary due to this study's focus on a single case.[225] In this research, the requirement of triangulation was fulfilled by both triangulation of data collection methods and data sources. This was done by, first, thorough document analysis of Dutch government white papers by use of desk research and, second, conducting semi-structured qualitative interviews with governmental and non-governmental experts on the subject of (COTS)-UASs.

3.2.2 Data collection methods

3.2.2.1 Document analysis of white papers: desk research

The researcher engaged in desk research, which involves analysis of textual material produced by other people.[226] With regard to the nature of this type of research, Verschuren and Doorewaard state the following:

Desk research is characterised by:[227]

1. The use of existing material, in combination with reflection;
2. The absence of direct contact with the research object;
3. The material is used from a different perspective than at the time of its production.[228]

One advantage of desk research is that it allows the rapid utilization of large amounts of data.[229] Furthermore, there was enough available material relevant to the Dutch case and COTS-UASs to allow for desk research to be conducted appropriately.[230] Lastly, the utilized documents came primarily from the Dutch government and regulators, which was an advantage in terms of their relevance and quality.

The white papers were analyzed from the research's safety and security perspectives presented in Chapter 2. The method of data analysis applied to with the white papers is called secondary research because it "rearranges existing data, and analyses and interprets this data from a different perspective…".[231] By doing so, this research could focus on the most useful information from the documents in terms of answering the research questions.

However, this focus on official government documents held the potential for a one-sided representation. To offset this potential, outside perspectives were included through qualitative interviews with non-governmental actors and stakeholders. A disadvantage of desk research could have been having no "direct contact with the research units".[232] However, this disadvantage was also offset by also conducting qualitative interviews with representatives of Dutch ministries, military personnel, and industry actors and stakeholders. This allowed for the inclusion of many different perspectives on a

[225] Verschuren and Doorewaard, *Designing a Research Project*, 2010, 181.
[226] Ibid., 157, 160, 194.
[227] American English grammar and spelling are used throughout this research, as opposed to the British "characterised" here.
[228] Verschuren and Doorewaard, *Designing a Research Project*, 194.
[229] Ibid., 198.
[230] Ibid., 199.
[231] Ibid., 196.
[232] Ibid., 199.

complicated process. Combining the data sources of white papers and expert interviews allowed for the cross-referencing of findings among data sources, as prescribed by Yin.

3.2.2.2 Qualitative semi-structured interviews as a data collection method

The following quotation describes the types of interviews that were used as a data collection method for this research:

> Unlike a survey, a qualitative interview is an interaction between an interviewer and a respondent in which the interviewer has a general plan of inquiry, including the topics to be covered, but not a set of questions that must be answered with particular words in a particular order.[233]

Before the start of each interview, the interviewee was given the opportunity to read the research information document and the research questions (see Appendices A and B). Often, a certain question or topic was addressed first due to an interviewee's expertise or because that subject was already being discussed. Some interviewees provided information on behalf of their organizations, and others provided information based on their personal and professional experience.

Using semi-structured interviews with open questions allowed the researcher to obtain the necessary qualitative information.[234] In addition, the semi-structured interviews allowed the interviewees to clarify the context of their own answers. This allowed regulators to explain why certain courses of actions were chosen and how they affected the regulatory process. It also allowed COTS-UASs actors and stakeholders, to clarify their experiences in terms of being subjected to the relevant regulations. Therefore, these methods of data collection were better suited to fulfilling the research objective than quantitative data collection methods such as surveys. Through the semi-structured approach, the interviewed experts were given the opportunity to express *their* opinions and views with regard to the development of the Dutch regulatory response to COTS-UAS technology.

3.3 Employed analytical strategy and technique

This research employed the analytical technique of process tracing, as this thesis wishes to clarify *why and how* the Dutch response came to be.[235] The results that were obtained through the application of this process are presented to the reader in a narrative form, which helps in constructing an accurate representation of the Dutch case.[236]

In order to ensure the accuracy of the narrative constructed based on both the white papers and the interviews, the following steps were taken: First, the strategy for analyzing the research data was to "follow the theoretical propositions" central to this case study.[237] Following these propositions meant following the causal links discussed in Chapter 2.[238]

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233 Babbie, *The Practice of Social Research,* 346.
234 Verschuren and Doorewaard, *Designing a Research Project*, 141.
235 Yin, *Case Study Research*, 147.
236 Ibid.
237 Ibid., 136.
238 Ibid., 147.

Finally, there is a need to address all of the evidence and to employ a clear and comprehensive analytical strategy in order to not "be vulnerable to alternative interpretations based on the evidence that you had (inadvertently) ignored".[239] Measures taken to ensure a reliable analytical strategy include the transcription and codification of the interviews. For the sake of data quality, the author listened to the interviews repeatedly in order to produce accurate transcriptions, and the interviewees were asked multiple questions to clarify and/or confirm or disconfirm certain statements. The analysis of the collected data is discussed later in this chapter alongside how this research ensured external validity. It is also important to formulate and consider "plausible or rival explanations".[240] This research's alternative and rival hypotheses can be found in Chapter 2.

3.4 The selection of data sources for both data collection methods

To answer the research questions, information was required both from the Dutch government and external sources regarding what influenced the Netherlands' regulatory response to COT-UASs. To obtain such information documents intended to inform the Dutch House of Representative on the state, progress, and influences on the regulatory response were selected.

3.4.1 Selection of data sources for document analysis

The research selected the following documents based on their relevance and origins. These white papers cover the *why* and *how* of the Dutch response during the research's time frame of 2015–2018. Of particular relevance were the letters used by the MIWM used to communicate the state of the regulatory development to the Dutch House of Representatives in 2016 and 2018. Furthermore, included are two studies conducted by the Netherlands's own institutions.

TABLE 03, Selected white papers.

Designation	Title	Date Published
OB313	Het Gebruik van Drones	2015
30806 NR. 28	Onbemande Vliegtuigen (UAV)	2 March 2015
30806 NR. 31	Onbemande Vliegtuigen (UAV)	28 August 2015
30806 NR. 36 IENM/BSK-2016/193700 2016 Voortgangsbrief	Onbemande Vliegtuigen (UAV)	29 September 2016
TNO 2015 R11721 UNCLASSIFIED	Final Report Technical Aspects Concerning the Safe and Secure Use of Drones	March 2016
30806 NR. 39 IENM/BSK-2017/49353 2017 Voortgangsbrief	Onbemande Vliegtuigen (UAV)	5 April 2017
30806 NR. 46 IENW/BSK-2018/88505 Voortgangsbrief 2018	Onbemande Vliegtuigen (UAV)	28 May 2018
BIJLAGE -> 30806 NR. 46	Handhavingsanalyse drones	28 May 2018
30806 NR. 48	Onbemande Vliegtuigen (UAV)	5 November 2018

[239] Ibid., 168.
[240] Ibid., 150.

Considered together, these documents permit tracing some of the most significant influences on the Dutch regulatory response between 2015 and 2018.

3.4.2 Selecting data sources for the interviews

With regard to the interviews, the research took a strategic sample of experts, as opposed to performing a survey among a random sample of people.[241] In addition, snowball sampling was attempted through the interviews. Experts on matters related to (COTS)-UAS, regulation, defense, aviation, and governance were considered the ideal participants.

3.4.2.1 Identifying experts and subsequent sampling

Identifying interviewees proved difficult when contacting organizations or individuals directly. Email communication proved time-consuming if and when replies arrived. Some interviewees were successfully approached directly, such as those from the MiJS, the Ministry of Infrastructure and Water Management, and the Royal Air Force.

The participation of most interviewees was secured through the researcher calling in a favor from a recruitment officer in the business world, who, on behalf of the researcher, performed a LinkedIn search query using search terms such as “UAS,” “RPAS,” and “the Netherlands”. The recruitment officer then contacted the individuals who appeared in the query with an offer to participate in this research. The potential participants were also provided with a brief explanation of the research’s objective and focus. This approach proved highly time-efficient and yielded cooperation from the aforementioned ideal types of participants. The interviewees stated that they were pleased with the courtesy with which they were approached to participate in the interviews.

As stated, snowball sampling was attempted through the participating experts. Unfortunately, certain recommendations proved unresponsive. Fortunately, certain organizations mentioned by the participants had already been contacted through the previously conducted LinkedIn searches meaning they were included in the research.

3.5 Conducting the interviews

The types of interviews conducted included face-to-face interviews, Skype calls with or without video, and even phone calls. Nine interviews were conducted during the fourth quarter of 2018; the expertise of the interviewees is presented in Table 4 listed below. In accordance with Yin’s protocol, an interview protocol was formulated and presented to the researcher’s supervisor during the preparations for these interviews.

Further details concerning the dates and locations of the interviews have been omitted in accordance with the confidentiality agreements made with interviewees. The transcriptions, which were made available to this research’s primary and secondary readers, offer more information concerning the expertise of various participants. However, much is omitted here, because such information could be used to identify the interviewed experts.

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[241] Verschuren and Doorewaard, *Designing a Research Project*, 179.

TABLE 04. Expertise of the nine participants (presented in random order)

Dutch Royal Air Force: Senior imagery analyst – full motion video	UAS entrepreneur, educator, and pilot	Representative of the Ministry of Justice and Security – Innovation Team
Representative of the Ministry of Infrastructure and Water Management	Space 53, innovation and business in the UAS sector.	UAS/Remotely Piloted Aircraft System (RPAS) flight instructor and engineer
Representative of Dutch Association for Remotely Piloted Aircraft Systems	Royal Netherlands Army, the challenges and adoption of COTSs and Military Off The Shelf UASs	Representative of the Royal Netherlands Aeronautical Association, UAS and (unmanned) aviation expert

Furthermore, some of the collected data is sensitive and is therefore not included out of respect for the participants' wishes. This is particularly the case for information concerning certain security measures that, while relevant to the research, were requested to remain covert. Finally, there were some statements that were not echoed by other interviewees; such standalone findings are not included due to an inability to confirm them with other data collected for this thesis.

It was important to formulate respectful but useful interview questions when dealing with representatives of the ministries, the military, and industry players in sensitive positions. A good way to ensure the comfort of interviewees was for the researcher to put himself into the position of said interviewees and reflect on how they would feel answering the questions.[242] Finally, the debrief questions served as a means of ensuring the continued ethical treatment of the interviewees. The interview questions can be found in Appendix B.

3.6 External validity

3.6.1 Transcribing the interviews

The interviews were audio recorded and transcribed in order to ensure external validity. Transcribing the interviews resulted in just under 91,000 words' worth of individual transcriptions. After all of the individual transcriptions were reviewed by their respective experts any feedback was incorporated into the transcription. All of the final transcription documents were combined to form the Masterwork Transcription Document (MTD). Before returning the recording device, double-checks were made to ensure that all sensitive information had been erased from it to ensure confidentiality.

3.6.2 Coding the interview data

This research first performed an open coding of the collected data in the transcriptions; thereafter, an axial coding of the transcription information into the code book was performed.[243] The code book categorized statements from the collected data based on their relevance to answering the research objective, the research questions, and the specific interview questions. The code book provided

[242] Babbie, *The Practice of Social Research*, 236.
[243] Ibid., 397-398.

a by-topic overview of the data, which was helpful in constructing a narrative from the recurring themes between interviews that served to explain the evolution of Dutch responses.

Each transcription was initially printed, read, and codified a first time. The transcriptions were then printed out in the form of the MTD, and a second coding was made using the already marked transcriptions, which resulted in a clearer analysis of the data to be axially coded and included in code book. The researcher was advised to create customized ways of codifying and understanding the results, which led to the creation of the code book. To ensure both external validity and confidentiality, the confidentiality-compliant transcriptions and the code book were submitted alongside the master's thesis but were only accessible to the first and second readers of this thesis from Radboud University.

3.6.3 The iterative approach and its effect on this research

A risk with the iterative approach can be research projects losing sight of their initial research objectives over time, as data and iterations may result in them moving towards different directions.[244] The priority is then to incorporate what is of use to the original research objective while identifying, but not overemphasizing, useful findings that could threaten the focus of a research project.[245] The author of this research sought to stay focused by following the case study protocol formulated by Yin.[246] However, this approach does not reduce the complexity of dealing with COTS-UASs in the context of S&S.

Interviewing non-governmental actors provided non-government perspectives, which helped to prevent a one-sided representation of the Dutch response. The knowledge gained from these interviews influenced the iterative case study research process.[247] This iterative approach gave greater insight into how regulation could be of help by mandating the incorporation of safety-by-design, security-by-design, and even privacy-by-design features into COTS-UASs, as these features enable the detecting, identifying, tracking, and attributing of S&S threats.

[244] Yin, *Case Study Research*, 150.
[245] Ibid.
[246] Ibid., 84-94.
[247] Ibid., 149.

Chapter 4: Results

To give structure to presenting the obtained date, each of the sub-questions (SQ) that feed into answering the main research question is addressed. This approach allows for discussion and analysis of the results in Chapter 5. The footnotes referencing the MTD are for the first and second readers and facilitate external validity.

4.1 SQ1: How did the technological development of COTS-UASs complicate or challenge the Dutch regulatory response?

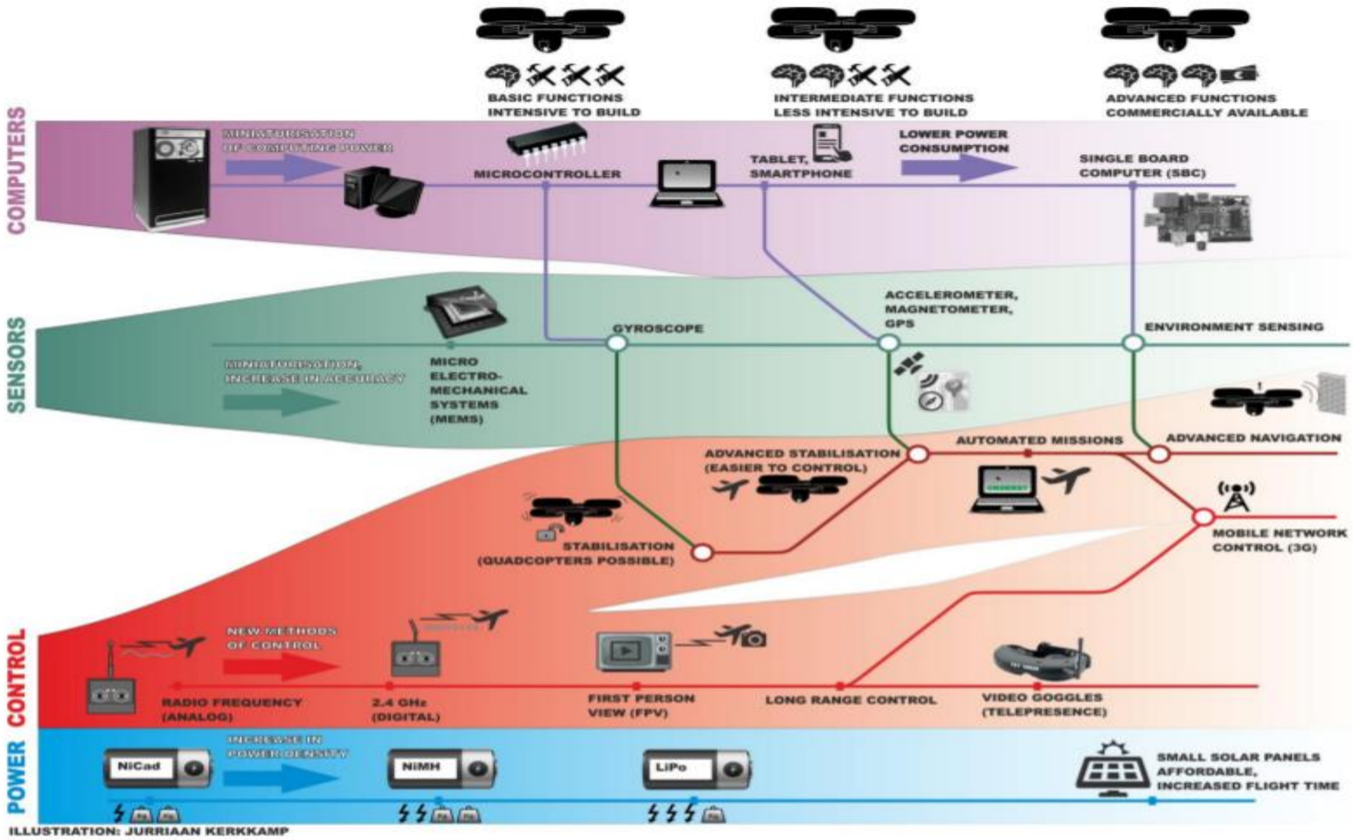
Early during the response process (i.e., in 2015), the Dutch Research and Documentation Centre (RDC) and the Netherlands Organization for Applied Scientific Research (NOASR) conducted research into COTS-UAS-related safety and security issues. As it was a major influence on the early 2015 regulations, the RDC's research is discussed under SQ3.

4.1.2 How the NOASR research and the interview data confirm the role of the rate and acceleration of COTS-UASs technology complicating the Dutch regulatory response.

The 2015 NOASR study published in 2016, after it had been declassified, and it led regulators to emphasize the importance of safety and security by design in their discourse.[248]

The NOASR's research had more of a focus on the technical nature of UASs than that of the RDC. The following Figure 6 shows how the simultaneous development of various technologies had compound effects with regard to drones.

[248] Tweede Kamer der Staten-Generaal, *Kamerstuk 30806 NR. 36*, 14.



Synergy among technology developments related to drones.

Figure 6, "Synergy among technology developments related to drones".[249]

As can been seen in figure 6, COTS-UASs have benefitted from many technologies but particularly from the smartphone.[250] This is because the popularity of smartphones has led to the miniaturization of multiple technologies that enhanced the capabilities of COTS-UAS.[251] However, developments other than those presented in the figure also had effects. An important influence was that of 3D printing.[252]

Advancements in 3D printing, together with the open source development of UAS designs and related software, allowed for "rapid prototyping and manufacturing" of COTS-UASs.[253] The progress made in 3D printing led to faster research and development (R&D), as 3D printing enabled changes to be rapidly included into R&D processes.[254] Combined, these developments made it easier, faster, and cheaper to develop and fabricate COTS-UASs.

[249] Elands et al., *Technical Aspects Concerning*, 11.
[250] Ibid., 11-12.
[251] Mommers, *Masterwork Transcription Document*, 120
[252] Ibid., 72, 113.
[253] Rao et al., *The Societal Impact*, 83.
[254] Mommers, *Masterwork Transcription Document*, 72.

Furthermore, the manufacturers of COTS-UASs are able to reinvest profits made through the sales of small, toy-like COTS-UASs into their businesses.[255] The money that COTS-UASs producers generated by selling cheap drones was used to develop more advanced and capable platforms during the early years of COTS-UASs proliferation. This positive feedback loop increased the rate at which the industry could invest in developing UASs. The money made with cheap toy-like COTS-UASs increased the rate at which the industry could invest in developing UASs by allowing for greater investments to be made in R&D efforts related to these systems.

The NOASR drew the following conclusion with regard to the ability of regulators to respond to the increasing rate and acceleration of COTS-UASs' technological development in 2015:

> In the area of drones, technology is developing in a very rapid pace. In addition, the number of drones sold annually…increases exponentially. It is hardly possible for the authorities to keep pace in establishing proper legislation and in enforcement of the laws.[256]

The proliferation of drones proceeded faster than responses could be formulated. The speed at which COTS-UAS first emerged, and continued to develop throughout the following years, challenged the established physical and regulatory structure of Dutch airspace.[257] The subsequent Dutch regulatory response was complicated due to a number of factors, which are discussed in the following paragraphs

4.1.3 The application of manned aviation perspectives to the topic of (COTS)-UASs

While rate and acceleration are important factors that challenged the development of the Dutch response, the interviews provided additional reasons for a disbalance between COTS-UASs developments and Dutch regulations. One of the complicating factors in terms of the emergence of drones was that the individuals tasked with regulating these devices applied manned aviation thinking to problems associated with unmanned aviation.[258]

In the interviews, the experts specifically mentioned that established manned aviation thinking had not been in sync with the development of smaller UASs. The interviewees, both those within and outside of government, stated that older manned aviation thinking was applied to COTS-UASs during the early phases of the regulatory process. As a consequence, early regulations were overly complicated and restrictive with regard to the professional use of COTS-UASs. Furthermore, interviewees noted that certain aspects of manned aviation regulations were not a good match for unmanned drones due to the technological developments COTS-UAS had undergone. These developments led to COTS-UASs being used differently than manned aviation.

The interviewees provided multiple examples that reflected Marchant, Wallach, Clarke, and Moses' concerns with regard to applying pre-existing (manned aviation) perspectives to emergent (COTS-UAS) technology.[259] The following examples highlight this. COTS-UASs mostly operate at low altitudes, where they represent a greater risk to those on the ground than in the air.[260] The experts mentioned that, despite being aircraft, it is difficult to apply established aviation regulations to COTS-

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[255] Ibid., 120.
[256] Elands et al., *Technical Aspects Concerning,* 67.
[257] Mommers, *Masterwork Transcription Document*, 118.
[258] Mommers, *Masterwork Transcription Document*, 72, 83.
[259] Clarke and Moses, *Public Safety*, 271-272.
[260] Mommers, *Masterwork Transcription Document*, 47.

UASs. However, early regulators were focused on keeping COTS-UASs from interfering with manned aviation which led to them applying established aviation regulation that facilitated this separation. However, in reality COTS-UASs mostly operate at relatively low altitudes, whereas conventional aviation mostly operates at high altitudes. In addition, criticisms were directed at the amount of foresight, or lack thereof, that early regulators had with regard to where the technology was going, and at what pace, during the early years of the response process.

A rule in manned aviation is that one has to fly at a certain height when flying over urban areas so that one can glide to a safe location in the event of technical difficulties. In reality, that restriction is not very applicable to many fixed-wing UASs used in the professional UAS sector. The fixed-wing UASs used by the Dutch professional sector actually "can glide better and longer than manned aircraft".[261] However, prohibiting flying over crowds or infrastructure made sense during the proliferation of cheap, less reliable multi-copters, especially when operated by uninformed and uncertified recreational users. Especially the volatile lithium-ion batteries used in popular drones present a public safety risk as they can cause fires after a crash. Interviewed experts were also of the opinion that untrained recreational users of COTS-UAS, using low-end drones, should keep their distance from crowds and infrastructure. The real issue that interviewed experts identified was that professional users had higher distance restrictions than recreational users. So whilst all UASs, either professional or recreational were not allowed to fly over interconnected infrastructure professional fixed-wing COTS-UAS are actually able to do so quite safely. However, under Dutch regulations, UASs are forbidden from flying over interconnected infrastructure and crowds for safety's sake.

Another example of manned aviation thinking is when professional UASs had to be equipped with a transponder when flying in controlled airspace. This requirement for a transponder, a staple of manned aviation, was eventually eliminated. While an airfield could detect a drone's transponder, this did not ensure that it had any means of contacting the pilot.[262] Furthermore, were this requirement to be implemented on a wide scale, it could clutter the identification systems of airfields, especially when one considers the expected proliferation of UASs. Therefore, the transponder requirement for COTS-UASs had more drawbacks than benefits.

4.1.4 How manned aviation thinking impacted the Dutch military's use of COTS-UASs

Another example of the application of manned aviation thinking to unmanned operations was provided by the Dutch military. The author was given insight into the military's regulations for certain aircraft. While not allowed to replicate these regulations in this research, the researcher was allowed to state that having to apply manned aviation perspectives to its use of small (< 25 kg) drones affected the military's use of both COTS-UASs and military off-the-shelf (MOTS)- UASs.

As time passed, strict manned aviation regulations, while appropriate for manned aircraft, became increasingly inappropriate with regard to military personnel needing to train with significantly smaller (< 25 kg) MOTS-UASs. However, as MOTS-UASs increase in size and fuel capacity such regulations do become more important in terms of ensuring safety for military personnel.[263] To conclude, for the Dutch military, having to apply pre-existing aviation rulesets to UASs resulted in relatively complicated

[261] Mommers, *Masterwork Transcription Document*, 100; my translation.
[262] Ibid., 17-18.
[263] Ibid., 69.

regulations being applied to simple UAS operations.[264] However, due to security reasons, related to software vulnerabilities in COTS-UASs, the Dutch military will no longer allow the use of COTS-UASs in the military from 2020 onwards.

4.1.5 Resource constraints

4.1.5.1 The number of people tasked with regulating COTS-UASs in the Netherlands

The interviewed experts were satisfied with the capabilities and knowledge of current regulators. However, interviewed experts expressed the wish that there had been more people tasked to regulate UASs, particularly during the earlier years of the response process. Response gaps occurred, and remain, due to the relatively limited number of people tasked to the COTS-UAS subject and because manned aviation regulations were applied to unmanned aviation. In addition, both the members of the government and the actors and stakeholders associated with COTS-UASs acknowledged the high workload of those currently tasked with regulating UASs. The interviews identified a need for more people with specific knowledge concerning UASs and unmanned aviation to address future developments.

4.1.5.2 Cosmopolitan challenges: the regulatory responsibility shift to the European level and the constraint of time

The shift of the regulatory responsibility to Europe (SRRE) made implementing national regulations increasingly inefficient. The complications stemming from the SRRE led to Dutch regulators facing challenges in terms of the cosmopolitanism as identified in Chapter 2.

During the March 2015 high-level meeting of the EU in Riga, the importance of implementing the same rules and regulations throughout Europe was established.[265] However, the European regulations were not expected to come into effect until 2019. Therefore, there would still be several years to bridge with national-level regulations.[266] While regulators first expected that European regulations would come into effect in 2019, recent developments suggest June 2020.[267]

Due to the need for EU-wide regulations, addressing national-level issues in the Netherlands became inefficient, leading to response gaps arose due to time constraints and inefficiency concerns. Implementing further updates was also expected to cause confusion in the UAS sector considering how briefly they would be in effect before the EU-level regulations took over.[268] Causing confusion with a new update might have resulted in unnecessary investments, from the Dutch UAS sector and the government, that would have to be altered when the European regulations would come into effect.[269] If a business invests in a particular unmanned traffic management (UTM) system, and Europe supports a different system later on, businesses run the risk of wasting valuable time and resources investing in the unadopted UTM system.

European regulations will restricts the weight of a drone that one may operate without registration to only 250 g.[270] This weight limit was based on the following finding; as a collision threat to

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[264] Ibid., 66.
[265] Tweede Kamer der Staten-Generaal, *Kamerstuk 30806 NR. 31*, 2
[266] Tweede Kamer der Staten-Generaal, *Kamerstuk 30806 NR. 36*, 5.
[267] Tweede Kamer der Staten-Generaal, *Kamerstuk 30806 NR. 31*, 3.
[268] Mommers, *Masterwork Transcription Document,* 133-134.
[269] Ibid., 133-134, 143.
[270] European Aviation Safety Agency, *Opinion no 01/2018 Annex*, 3.

manned aviation, the EASA's Drone Collision Task Force deemed drones below 250g "'harmless.'"[271] While updates to the Dutch recreational ruleset, intended to address response gaps to safety issues, were drafted, implementing them was no longer deemed efficient in 2017, which led Dutch regulators to decide to conform to European regulations.[272]

Parts of the proposed Dutch regulations intended to further restrict recreational use were not future-proof when compared to European regulations, as data from EASA's "Impact Assessment" showed that safe operations could still be conducted beyond the boundaries proposed by the Netherlands.[273] For example, Europe determined that UASs can safely fly at heights of up to 120 m, as opposed to the 50 m proposed in the Dutch 2017 update. Furthermore, European regulations will mandate theoretical requirements intended to ensure airmanship for all COTS-UASs heavier than 250 g.

Because of the SRRE, updating Dutch regulations became increasingly inefficient in terms of time and resources; prevented the closing of specific response gaps. Further explanations for forgoing updates to the Dutch regulatory framework include restrictive legal requirements (as a result of having applied manned aviation rules to UASs) increasing the time it took to draft and pass regulatory updates.

4.1.5.3 Cosmopolitan challenges and transparency

COTS-UAS regulation and means of ensuring transparency, such as unmanned traffic management systems (UTMs), needed to extend beyond the borders of the Netherlands to ensure a "level playing field" among nations and to enable oversight and enforcement by other European police forces.[274] The Netherlands hoped to attain transparency into drone operations through European-wide regulations requiring that certain features be pre-installed on COTS-UASs.[275]

Therefore, while means of transparency already exist, they are used independently by actors in the sector, as Europe has not yet decided on a particular system.[276] The interviews demonstrated that the professional sector employed its own means of transparency in the interim.[277] This allowed actors in the professional sector to detect, identify, and track multiple UASs in real-time, as well as to attribute them to their pilots. However, the size of the Dutch market was not sufficiently large to demand the implementation of safety- and security-by-design features from the COTS-UAS industry.[278] Therefore, the professional UAS sector promoted safe operations and even self-policed businesses that violated Dutch regulations.[279] The size of the Dutch market therefore prevented national regulation to demand design-in and design-out features.

The need for a European-level playing field prevented national regulation of safety- and security-by-design features in the Netherlands. Therefore, the Netherlands had to ensure safety by other means

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[271] Qtd in de Jager, *Amper Gevaarlijk voor Grote*.
[272] Tweede Kamer der Staten-Generaal, *Kamerstuk 30806 NR. 46*, 7.; Mommers, *Masterwork Transcription Document*, 133-134.
[273] Tweede Kamer der Staten-Generaal, *Kamerstuk 30806 NR. 46*, 8.
[274] Mommers, *Masterwork Transcription Document*, 136.
[275] Tweede Kamer der Staten-Generaal, *Kamerstuk 30806 NR. 39*, 4.
[276] Mommers, *Masterwork Transcription Document*, 137.
[277] Ibid., 18.
[278] Tweede Kamer der Staten-Generaal, *Kamerstuk 30806 NR. 36*, 14-15.
[279] Mommers, *Masterwork Transcription Document*, 123.

until European regulation came into effect.[280] However, mandatory electronic identification features for COTS-UAS are part of the European regulations that will come into effect in June 2020.[281] Instead, immunization against safety issues in the Netherlands was attempted through mandating safe zones, professional certifications, and by means of public awareness campaigns intended to promote airmanship among recreational COTS-UAS users. The focus on informing recreational users came from the fact that high levels of airmanship are already ensured with Dutch professional users, a point echoed by both industry actors and government representatives.[282]

4.1.6 The resource of available data

Dutch regulators stated that a lack of available data on the actual safety risks posed by UASs was also an obstacle to formulating early regulations.[283] Therefore, regulators had to first invest time and effort into data collection after the proliferation of COTS-UASs required a regulatory response. This lack of data concerning safety threats to manned aviation, alongside the rising trend of COTS-UASs incidents associated with recreational use, was noted in early 2015.[284] To obtain adequate data on which to base policy, the Inspectorate of the MIWM, together with other parties, started to register COTS-UAS-related incidents.[285]

Initial data was obtained through research such as that conducted by the RDC and NOASR. In subsequent years, regulators sought to obtain more accurate data by having UAS users report both incidents and successful operations.[286] Regulators found that tracking successful operations, alongside incidents with COTS-UAS, allowed for a better understanding of the reality of drone operations and what measures should or should not be implemented in terms of public safety.[287]

4.1.7 The technical quality of cheap COT-UASs

COTS-UASs proliferated on the market before technical standards could be regulated. Dutch regulators currently perform quality control of (professional) COTS-UAS themselves. These tests are necessary due to the lack of industry production standards. With the predicted proliferation of COTS-UASs, inspecting individual craft will become an unsustainable endeavor for regulators.[288]

The issue of cheaper UAS not satisfying certain reliability standards was also identified by academics in 2016.[289] Interviewees from the UAS sector also stated that the reliability and redundancy issues associated with cheap COTS-UASs were a problem. However, the more unreliable craft are actually the smaller, cheap multi-copters that are popular with the general public. The professional sector tends to use more reliable UASs.

It was noted by the interviewees that prescribing technical standards for COTS-UASs is a difficult undertaking both due to the small size of the Dutch market and the foresight required to accommodate

[280] Mommers, *Masterwork Transcription Document*, 133-134.
[281] de Jager, *Europese Drone Regelgeving*.
[282] Mommers, *Masterwork Transcription Document*, 102, 141.
[283] Tweede Kamer der Staten-Generaal, Kamerstuk 30806 NR. 28, 5.
[284] Ibid.
[285] Tweede Kamer der Staten-Generaal, Kamerstuk 30806, NR. 31, 14-15.
[286] Mommers, *Masterwork Transcription Document,* 131.
[287] Ibid.
[288] Mommers, *Masterwork Transcription Document,* 119.
[289] Rao et al., *Societal Impact*, 86.

future technological developments. Eventually, the requirement for *Conformité Européene* (CE) markings intended to ensure technical standards became part of European regulations for UASs. Due to the desire to implement uniform regulations throughout Europe and the limited size of the Dutch market, productions standards were not formulated specifically for the Netherlands.

4.1.8 Ensuring airmanship with COTS-UASs: the professional and recreational rulesets

Because COTS-UASs allow easier access to airspace, the following issues complicate the Dutch response: First, there is a challenge in ensuring that all buyers of COTS-UASs had the appropriate knowledge and skills to fly safely. Second, the technical quality of cheap COTS-UASs presents safety issues. Third, COTS-UASs challenge the Dutch government's hegemony over its airspace. Furthermore, the proximity of interesting locations for commercial UASs activities to airfields, and the overall infrastructural density of the Netherlands, complicates matters. This separates the Netherlands from other countries where locations of interest to COTS-UAS operations are not as close to important infrastructure or major airfields.

The ability to fly-out-of-the-box with a COTS-UASs means that operators can easily access airspace without any authority ascertaining their airmanship. Ensuring airmanship is important in terms of public safety regardless of who uses a drone or why. The interviewees made it clear that both appropriate levels of airmanship and safety-by-design features can greatly improve the safety of drone operations, as safety-by-design features on their own cannot substitute for airmanship. For example, it was mentioned that incidents also occur due to people relying excessively on the built-in safety features of COTS-UASs.

While airmanship was successfully ensured with professional users, this proved difficult with laymen purchasing COTS-UASs. Uncertified individuals should abide the recreational ruleset, however under the recreational ruleset one can legally operate COTS-UASs of up to 25 kg without checks on airmanship.[290] The Dutch recreational ruleset allows use of UASs of up to 25 kg, as opposed to the 250 g identified by the Impact Assessment, as a result of model aircraft regulation being applied to COTS-UAS. Because updating regulation became inefficient due to the SRRE, this was not corrected through regulation. Regulators instead focused on public awareness campaigns intended to promote airmanship among recreational users.

4.1.9 Dutch airspace: a combination of restricted airspace and infrastructural density

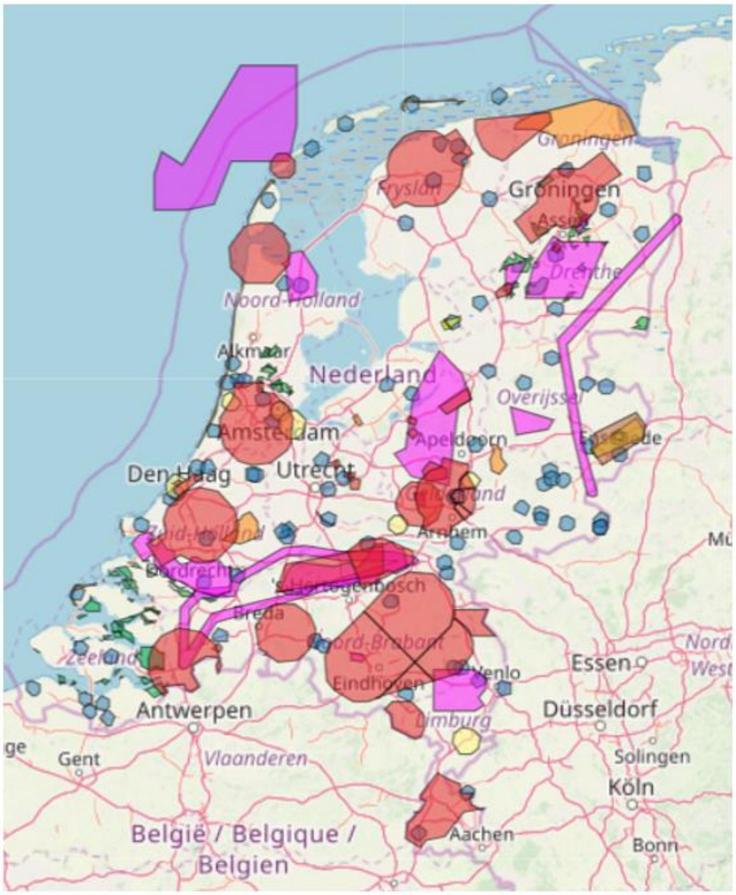
Interviewees stated that the Netherlands traditionally enforces strict control of its airspace. Anything that loses contact with the ground is technically subject to Dutch airspace regulation. Before the emergence of COTS-UASs, it was very clear who did, or did not, have access to Dutch airspace. Traditional model aircraft clubs also had clear spaces within this system where they could fly safely and responsibly. However, the development of COTS-UASs allowing easier access to airspace changed everything.

In addition, the interviewees stated that interesting locations for commercial drone operations are also close to, or within, controlled traffic regions, and that these include major infrastructure important to both regulators and citizens.[291] Major, densely inhabited parts of the Netherlands are surrounded, or covered, by Controlled Traffic Regions (CTRs) and no-fly zones. Therefore, infrastructure

[290] Mommers, *Masterwork Transcription Document*, 8.
[291] Ibid., 142-143.

important to the security of the Netherlands is an additional factor in demarcating Dutch airspace. Overall, the infrastructural density of the Netherlands was a complicating factor in the response process; this can be seen in Figure 7, which is intended to make it easier for the reader to understand the complexities of Dutch airspace.

Figure 7, “CTR the Netherlands”.[292]



Legend:
Red: No-fly zone; flying forbidden.

Dark blue: Controlled airspace (CTR); flying forbidden.

Light blue circle: uncontrolled airfield, glider field, or heliport; flying only allowed with permission of controller.

Pink/orange: Low-flying area; flying allowed under supervision (second visual observer).

Green: Natura-2000 areas in which drones are forbidden.

Safety issues were first addressed by restricting COTS-UASs from operating in large parts of Dutch airspace (e.g., by banning them from areas that are frequently used by manned aviation). However, at the edges of these zones, UASs and manned aviation are hundreds, if not thousands, of meters apart vertically.[293] Therefore, banning UASs from these zones completely in order to separate manned and unmanned aviation does not reflect reality.

Interviewees mentioned that the UAS sector understands the government wanted to keep both manned and unmanned aviation safe. However, many current measures banning COTS-UAS from certain locations reflect established manned aviation perspectives, instead of taking into account the reality of e.g. fixed-wing professional UASs. Furthermore, considering COTS-UASs mostly operate at significantly

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[292] Aeret, *CTR the Netherlands*.
Legend: my translation. The map in Figure 7 is subject to change (especially concerning Natura 2000 areas which are not part of this thesis’ focus), but serves to show how CTRs and no-fly zones cover large and important parts of the Netherlands.
For a browser-friendly, up-to-date map showing Natura-2000 areas: https://kadata.kadaster.nl/dronekaart/

[293] Mommers, *Masterwork Transcription Document*, 11, 72.

lower altitudes than manned aviation drones are banned in large areas where, during regular UAS operations, manned aviation and UASs would be separated by hundreds, if not more, meters vertically.

A case involving the operation of several unidentified COTS-UASs within the CTR of Schiphol Airport caused concern among regulators. Initially, it was not possible to identify the background of the those UAS operators due to transparency issues in terms of detection, identification, and attribution. Given this incident, and the lack of sufficient data upon which to base decisions, regulators banned UASs from large parts of Dutch airspace. Later, because of data collection efforts by regulators (supported by the UAS sector), restrictions for professionals were gradually alleviated.

Specific drone manufacturers chose to implement geofencing in their drones, but this was not mandated by Dutch regulations. For recreational users who intentionally or by accident attempt to fly in restricted zones, geofencing can prevent most COTS-UASs from taking off.[294] However, the current geofencing zones do not perfectly reflect the Dutch CTRs; in fact, some manufacturers have even increased the size of the no-fly zones to ensure coverage.[295] However, geofencing occasionally prevents the use of UASs for experiments and public demonstrations and even the police from taking off with their own COTS-UASs.

4.1.8 The role of the plurality of regulators, actors, and stakeholders

Coordination between regulators actors and stakeholders was done through several meetings that regulators held over the years with UAS actors and stakeholders.[296] These meetings were considered beneficial in terms of providing both data, expertise, and outside perspectives on COTS-UASs.

However, obstacles to reacting to COTS-UASs developments swiftly included the plurality of ministries, information, actors, and stakeholders. More specifically, a major issue was that regulator updates had to be reviewed by other government entities. This meant that, when the MIWM felt that it had developed a good set of regulations, it took time for these regulations to be reviewed by all government parties involved, each of which had their own interests. Subsequent conflicts of interests and legal restrictions stemming from having applied dated manned aviation regulations sometimes hindered the speed at which regulators could implement updates.[297] Such issues also occurred on the European level between the interests of individual member states and the need for a European level-playing field.[298]

4.2 SQ2: How do the current regulatory measures for COTS-UASs deal with safety issues in order to integrate this technology into Dutch society?

4.2.1 Immunization through certification: ensuring public safety through safe zones, proximity restrictions, and certifications

The Dutch regulatory response addressed safety issues by differentiating between professional and recreational types of use (also called the “rule-based” approach) by means of different certification requirements and weight and proximity restrictions.[299] For example, proximity restrictions mean that a

[294] Ibid., 11.
[295] Ibid.,13.
[296] Ibid., 49, 54
[297] Ibid., 143, 144.
[298] Ibid., 137.
[299] De Jager, *Invoering van de Europese*.

pilot must keep a certain distance from "crowds of people, interconnected buildings, roads, railroads, works of art, industrial areas, ports, and other traffic".[300] Imposing proximity restrictions serves as a form of immunization against accidents due to the unreliable technical quality of cheap COTS-UASs.

These proximity restrictions found support in 2015, when government data showed that, when incidents did occur, safe zones protected against collateral damage.[301] Although these measures do not mandate safety-by-design features, they are still a form of immunization against safety issues, as safe zones prevent further harm from crashes or other accidents. In a June 2015 publication by the Dutch HETI, it is stated that

> Relatively many hard landings and crash landings occur involving companies with an exemption. With one exception, these incidents are reported to have occurred inside the compulsory safety zone, where no people or traffic are allowed. A valid conclusion from this is that designating a safety zone is essential.[302]

Although not sustainable for the future of the professional sector, the 2015 proximity restrictions proved effective in preventing harm as a result of safety issues. It is important to bear in mind that the aforementioned crashes and hard landings occurred in 2015 and the number of incidents involving professional users has decreased over time over time.[303] To understand how safe zones and certifications ensure public safety, the two professional rulesets must be explained, as these certifications are intended to increase public safety by promoting airmanship on the part of users of COTS-UASs and allow transparency into professional operations.

4.2.2 The two professional rulesets

4.2.2.1 The Remotely Piloted Aircraft System Operator Certificate

The Netherlands made the use of drones for commercial purposes legal on July 1st 2015,[304] meaning that, by obtaining a Remotely Piloted Aircraft System Operator Certificate (ROC), professionals could legally fly drones commercially. The Dutch regulations then differentiated between two types of users based on their intent: professional (commercial) or recreational use.

The ROC-holding professional users were held in high regard by all the interviewees. The regulators interviewed were not concerned about safety issues with regard to ROC professionals. Having made high investments, ROC holders have a significant interest in conducting safe operations. Besides the cost of their aircraft, ROC holders are also invested in the public image of their businesses and the image of the entire COTS-UAS sector. The educational requirements that ROC holders must satisfy and the regulatory controls that apply to them further ensure safe operations.

Businesses that hold an ROC have had to invest between 10,000 and 15,000 euro. ROC Pilots themselves need an Remotely Piloted Aircraft License (RPA-L) and must undergo a medical examination, while their UASs need to be registered and insured and must pass a technical examination. [305]

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[300] Dijksma, *Regeling van de Staatssecretaris 30 Mei 2016*, Artikel 10a, 1d; my translation.
[301] The Human Environment and Transport Inspectorate, *Incidents involving drones*, ABL June 2015, 2, 3.
[302] Ibid., 3.
[303] The Human Environment and Transport Inspectorate, *Voorvallen met recreatieve en*, ABL June 2017, 1.
[304] Tweede Kamer der Staten-Generaal, *Kamerstuk 30806 NR. 31*, 3.
[305] Royal Netherlands Aerospace Centre, *Drone Centre Schema ROC*.

Furthermore, obtaining an ROC includes writing their own operations manuals and having these approved by the government.[306] All of these measures ensure that safety issues are addressed adequately during operations involving ROC professionals.

Data shows that safety issues rarely occur with ROC professionals.[307] With regard to safety issues the professional ruleset ensures high levels of safety, whereas the recreational ruleset does not.[308] An important difference between incidents between recreational and professional users is that, with professional users, safety issues generally arose due to either steering mistakes, manned aviation entering UAS airspace, or technical difficulties with the craft.[309] These issues are distinct from those that arise due to either unconcerned or uninformed recreational flyers breaking their proximity restrictions and entering restricted airspace. Finally, even when incidents occurred involving ROC holders, this did not result in damage to third parties, only damage to the craft themselves.[310] The interviewees indicated that they believed that any potential for further improving safety with regard to ROC holders lies in ensuring the quality of COTS-UAS and mandating safety-by-design features in newly produced COTS-UASs. Finally, certified businesses are also subject to audits by the MIWM's Inspectorate.

Actors in the aviation sector and regulators have made efforts towards the development of special operations risk assessments (SORAs).[311] By use of a SORA, even professional operations within CTRs became possible for ROC-certified users.[312] Furthermore, in the course material used in the professional certification process, there is particular focus on formulating risk assessments and responses.

4.2.2.2 The minidrones ruleset/ROC-Light

Compared to many simple UAS operations (e.g., photography and filming), many regulators, actors, and stakeholders felt that full ROC was excessive in its requirements. To make simpler forms of commercial use legal, regulators introduced new regulations on July 1st 2016, resulting in the creation of the Remotely Piloted Aircraft System Operator Certificate – Light. The ROC-Light required registration of both craft and pilot, that a pilot obtain insurance for his or her craft, and a theoretical exam. This less restrictive ruleset enabled commercial use UASs of up to 4 kg, albeit under stricter proximity restrictions.[313] The ROC-L came with stricter limitations on UAS weight, maximum altitudes, and minimum safe distances.[314] Professionals using UASs of under 1 kg could request an exemption from the theoretical exam.[315] An ROC-Light costs around 1,500 euro, which is significantly less than the cost of an ROC. However, actually obtaining the ROC-Light certification can take up to six months.[316] The administrative time it takes to obtain an ROC-L was considered excessive by interviewed UAS-professionals.

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306 Ibid.
307 The Human Environment and Transport Inspectorate, *Voorvallen met recreatieve en*, ABL June 2017, 1-2.
308 Mommers, *Masterwork Transcription Document*, 43.
309 The Human Environment and Transport Inspectorate, *Voorvallen met recreatieve en*, ABL June 2017, 1.
310 Ibid., 2.; Mommers, *Masterwork Transcription Document*, 34.
311 Mommers, *Masterwork Transcription Document*, 103.
312 Ibid., 101.
313 Tweede Kamer der Staten-Generaal, *Kamerstuk 30806 NR. 36*, 5-6.
314 Tweede Kamer der Staten-Generaal, *Kamerstuk 30806 NR. 46*, 6.
315 de Jager, *Moet ik een ROC-Light*.
316 Mommers, *Masterwork Transcription Document*, 48.

The ROC-Light's effect on public safety was deemed positive by the interviewees. One interviewee, who was involved in creating the ROC-Light, criticized the fact that the ROC-Light does not require a practical exam (to ensure Airmanship) similar to that required to obtain a driver's license. Furthermore ROC-Light users tended to operate cheaper systems which, in general, have lower fabrication standards and almost no redundancy precautions.[317]

Because of issues with ensuring airmanship with out of the box uncertified fliers, multiple interviewees supported mandatory certification for *all* use of UASs. Such a certification process would be similar to that required to drive a car or ride a scooter. Furthermore, certification would require a user to demonstrate a certain level of airmanship, which is beneficial in terms of public safety. Finally, regulators of COTS-UASs have also discussed and expressed support for such a form of certification for all COTS-UASs.[318] Many interviewees wished that all buyers of COTS-UASs would be required to educate themselves and register their UASs (with the exception perhaps of the simplest and smallest toy drones, which can be operated using only a cellphone's wifi signal).[319]

To address the issue of cheap unreliable COTS-UAS, regulators implemented a larger safety zone for the ROC-L. The interviewees supported the choice of regulators to implement a larger safety zone due to the lower certification requirements for the ROC-L. The factors that influenced these decisions are discussed under SQ3.

The interviewed members of the Dutch government acknowledged that the current rules and regulations governing professionals might still be too strict given the expertise of professional users.[320] However, the professional restrictions are in place due to uncertainties associated with the technology, not the capabilities of ROC holders. Therefore, the enforced proximity and weight restrictions are a form of immunization intended to increase resilience against technical mishaps.

4.2.3. The difference between the professional and recreational rulesets

Although critical of certain aspects, the interviewees regarded the initial regulations on professionals as a first attempt that allowed the Dutch UAS sector to emerge and develop. However, the manner in which early professional regulations addressed weight limits, as well as the corresponding height and proximity restrictions, proved to be cause for debate, as the recreational ruleset does not feature these restrictions of the professional ruleset. [321] This lead to a discrepancy in that recreational users had more freedom in operating heavier UASs than did professional users.

Over time, proximity restrictions for professional use were changed; the current limits are presented in Table 5. No up-to-date, translated, schematic overview of Dutch regulations for all types of use could be found leading to the creation of Table 5. This table presents the Dutch proximity restrictions relevant to this research. The discussion of these regulations is limited as addressing all of the related regulations would require an excessive amount of space. More importantly, the table demonstrates some of the discrepancies identified between the recreational and professional rulesets.[322]

[317] Clarke and Moses, 2014, public safety, 265.
[318] Mommers, *Masterwork Transcription Document*, 140.
[319] Ibid., 103.
[320] Ibid., 25-26.
[321] Tweede Kamer der Staten-Generaal, *Kamerstuk 30806 NR.* 31, 5.
[322] Research and Documentation Centre, *Het gebruik van Drones,* 148, 149.

TABLE 05: Final set of proximity restrictions in the Netherlands (post-2017 update)[323]

Type of use	Recreational	ROC-Light	ROC when operating a drone of between 0–25 kg	ROC when operating a drone between 25–150 kg
Maximum take-off weight	25 kg	4 kg	25 kg	150 kg
Minimum safe distance from crowds of people, interconnected buildings	Not directly above	50 m	25 m for (Heli/multi copters) 50 m for (fixed-wing/other aircraft)	150 m
Minimum safe distance to works of art, railroads, watercraft, other vehicles	Not directly above	50 m	25 m for (Heli/multi copters) 50 m for (fixed-wing/other aircraft)	50 m
Minimum safe distance to ports, industrial areas	Not directly above	50 m	n/a	50 m
Maximum horizontal distance between pilot and craft (visual line of sight on the craft must be maintained)	Not specified	100 m	500 m	
Maximum flight height	120 m	50 m (40 m in designated low-flying areas)	120 m	
Can be operated in controlled airspace/CTR	No	No	Yes	
Proximity restrictions can be temporarily waivered	No	No	Yes	

323 de Jager, *Mag ik met een ROC-Light*.; Rijksoverheid, *Regels voor recreatief gebruik*.; Schultz van Haegen, *Regeling Modelvliegen*.

4.2.3.1 Ambiguity in, and discrepancies between, professional and recreational regulations

The following examples present cases in which *uncertainty* and *ambiguity* resulted in disconnects, or gaps, between Dutch regulations and the reality of the development of COTS-UASs. This ambiguity occurred due to the terminology used in the regulations themselves, as well as the fragmented nature of the sources from which much information was obtained.[324] It is worth noting that the definitions used in the regulations, such as those of *crowds* or *interconnected buildings*, were deemed excessively ambiguous in both the white papers and by the interviewed experts. In fact, these terms specifically led to issues in terms of the interpretation and enforcement of the rules.[325] Therefore, ambiguity in the regulations led to problems for regulators, enforcers, and Dutch UAS actors and stakeholders.

Without a clear limit, what constitutes *visual line of sight* (VLOS) is also open to interpretation. The interviewees remarked that being able to maintain VLOS and still being able to conduct safe operations are two different things. Compared to the 500 m VLOS limit for ROC and 100 m for ROC-L users, the lack of such a limit for recreational poses a risk. Recreational users are subject to no maximum flight distance, only an ambiguous requirement to maintain line of sight with the craft.

Whereas the regulations that apply to professionals are stricter and include safe zones, the recreational ruleset allows uncertified operators to fly farther from the operator, closer to crowds and infrastructure, without the knowledge that ROC and ROC-Light holders must demonstrate to get certified.[326] Meanwhile, recreational users can use COTS-UASs up to 25 kg.

4.2.3.2 Safety issues associated recreational ruleset as a result of applying model aircraft regulation to COTS-UASs

The fact that the rules governing recreational use were less strict than those of the professional rulesets poses a risk to public safety because recreational users can use heavier drones in close proximity to vulnerable infrastructure and people. COTS-UASs of up to 25 kg pose greater safety concerns than the 4kg allowed under the ROC-Light, especially when combined with lower levels of airmanship. The interviewees deemed the discrepancy between recreational users and ROC/ROC-Light holders as a distinct risk to public safety.

The inconsistencies associated with recreational ruleset in terms of public safety were deemed to be one of the greatest issues with the Dutch response, and one that was considered unfair to professional users by both the UAS sector and regulators.[327] The fact that certain people, without having made the same level of investments as ROC and ROC-L holders, could illegally profit through the use of COTS-UASs was often mentioned as a problem by interviewees.[328] Furthermore, the recreational ruleset sends the wrong signals to uncertified users due to the lack of higher proximity restrictions for recreational use.

Recreational users can technically fly next to a crowd and not violate the rules, as the rules only state that they cannot fly *above* certain objects. However, in the event of an accident, a UAS can still drift several meters horizontally, which is exactly why professional users have minimum safe distances they

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[324] de Jager, *Moet ik een ROC-Light.*
[325] Tweede Kamer der Staten-Generaal, *Bijlage Kamerstuk 30806 NR. 46*, 1-2.
[326] Rijksoverheid, *Welke vergunning heb ik?*
[327] Mommers, *Masterwork Transcription Document*, 133.
[328] Ibid., 74-75, 118, 130-131.

need to keep.[329] Either as a result of a direct impact or its lithium-ion battery causing a fire, a crashing drone presents clear public safety risk.[330]

A common fear in the professional sector concerns a recreational drone colliding with manned aviation or cause grievous bodily harm. Initially, the fear of the Dutch UAS sector was not whether such an accident would occur but when; a particular concern in this regard was the number of untrained operators flying drones out of the box. Fortunately, and to the relief of professional ROC and ROC-Light holders, to date, no such grievous incidents have occurred.[331] Those incidents that did occur in controlled airspace, as well as the majority of intrusions into manned aviation airspace, were largely due to uncertified recreational users.[332]

4.2.4 Why the recreational ruleset Is an example of the risk of applying previous regulation to new technologies.

It is important to recognize that the recreational ruleset for COTS-UAS is in fact updated model aircraft regulation stemming from 2005. It is then unfortunate that these model aircraft regulations were applied to recreational COTS-UASs. Including COTS-UASs in older model aircraft regulation led to a mismatch between the model aircraft regulations and how recreational COTS-UASs were used in the Netherlands.[333]

Both the lower financial cost of COTS-UASs and their tendency to feature on-board cameras have led to different types of use than those associated with traditional model aircraft.[334] Especially when more people started using COTS-UASs when they discovered that they could make money by taking photographs or recording videos with such systems.[335] Of course, doing so without a professional certification would be in violation of the law.

Initially, recreational drones could fly up to 300 m, just as model aircraft were allowed, but this was changed to 120 m in 2015.[336] In reality, recreational COTS-UASs and model aircraft are two very different subjects that have been dealt with under the same set of regulations. For model aircraft hobbyists, safety is actually a result of flying higher than 120 m actually improves safety, as doing so allows them to respond to poor conditions or malfunctions.[337]

Because the model aircraft hobby and recreational COTS-UASs were placed under the same regulations the changes necessary due to COTS-UASs also affected the model aircraft hobby. In reality, non-certified COTS-UAS users differ greatly from traditional model aircraft hobbyists. The interviewees repeatedly stated that model aircraft enthusiasts spend the majority of their time building their aircraft, as part of their hobby, as opposed to flying their craft.

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329 de Jager, *Mag ik met een ROC-Light.*
330 Elands et al., *Technical Aspects Concerning*, 17.
331 Mommers, *Masterwork Transcription Document*, 33, 121.
332 The Human Environment and Transport Inspectorate*, Voorvallen met drones/RPAS*, ABL July 2016.; The Human Environment and Transport Inspectorate, *Voorvallen met recreatieve en*, ABL June 2017.
333 Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR.* 28, 8.
334 Ibid., 8.
335 Mommers, *Masterwork Transcription Document,* 107-108.
336 Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR.* 31, 3.
337 Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR.* 39, 2.

The interviewed experts confirmed that, with COTS-UASs, the enjoyment does not lie in building and testing the aircraft; rather, the enjoyment lies in achieving something through flying (e.g., aerial photography). Furthermore, model aircraft hobbyists tend to have high levels of airmanship due to their involvement with model aircraft clubs and the nature of the hobby. These assurances of airmanship do not exist for fly-out-of-the-box enthusiasts.

4.2.5.1 Key oversight and enforcement problems due to transparency and attribution issues

Transparency and attribution problems makes the police's job of enforcing COTS-UASs regulations difficult; determining whether a COTS-UAS is being used for recreational or professional purposes is effectively impossible with the naked eye or with readily available information.[338] Furthermore, when the intentions of an operator are unclear, it is equally unclear which ruleset should be applied.

In discussing the state of the Dutch oversight and enforcement capabilities on COTS-UASs in 2015, the NOASR stated that "at this point in time it is quite difficult to detect, classify and identify a drone let alone determine its intention".[339] In 2017, the police still had to resort to searching for pilots of trespassing drones on the Internet.[340] A police spokesperson stated that more conventional methods of identifying those responsible were insufficient due to most drones only being airborne for short amounts of time.[341] These statements indicate that difficulties exist in terms of identifying, locating, and punishing those responsible for transgressions involving COTS-UASs. Due to problems with regard to enforcement, intentional transgressions of the rules by either recreational or unconcerned professional users are not successfully deterred.[342] In fact, many of the interviewees would have preferred stricter enforcement of the regulations, as this may have led to clear precedents and punishments for those who did violate the rules.

The real-time enforcement of UASs requires cooperation between two separate branches of the police: the Police Aviation Service and the regular police. However, while members of the Aviation Service have access to the means required to detect UAS, they do not have the authority to make arrests.[343] Detecting and apprehending transgressing COTS-UASs therefore requires additional communication between two police organizations. However, the aforementioned detection equipment is not widely available to the Police Aviation Service.[344] Finally, Interviewees mentioned police personnel shortages as a further obstacle to enforcement.

Regulators intended to address the recreational ruleset by making recreational use only possible through model aircraft associations and at pre-designated locations.[345] In 2016 and 2017, regulators did in fact draft a new recreational ruleset; however, the impending European regulations led Dutch regulators to not execute this ruleset. Therefore, Dutch regulators had to address safety issues associated with recreational COTS-UASs by means other than regulations. This was done by promoting

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338 Tweede Kamer der Staten-Generaal, *Bijlage Kamerstuk 30806 NR. 46,* 2.
339 Elands et al., *Technical Aspects Concerning*, 23.
340 De Jager, *Politie houdt grootschalige online*.
341 Ibid.
342 Mommers, *Masterwork Transcription Document*, 43.
343 Ibid., 19.
344 Ibid., 40, 50.
345 Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR.* 31, 4.

airmanship among buyers of COTS-UASs, public awareness campaigns, and providing more up-to-date information on no-fly zones for UASs.[346]

In pursuing these ends the government even cooperated with sellers of UASs to distribute educational material. Although the number of incidents involving recreational drones increased between 2014 and 2017, it declined in 2018.[347] Whether this decline occurred due to the efforts of regulators or other factors could not be concluded based on the data used in this research.

While the professional rulesets effectively ensures public safety, uncertified transgressors are undeterred due to a low level of transparency, attribution and the enforcement of the regulations. This led to uncertified individuals (and even a few ROC-Light holders) making money through illegal COTS-UAS operations. In turn, the Dutch UAS sector took it upon itself to self-police these transgressors and report illegal commercial operations to the authorities.[348]

4.2.5.2 Caveats to the attribution problem with COTS-UASs in the Netherlands

Although the rules are clear with regard to the punishments that will be meted out to transgressors, actually catching transgressors is difficult. To be able to identify COTS-UAS in real-time, it would be necessary to draw from accurate and up-to-date databases.[349] It would be important that these database do not become cluttered to such an extent that they effectively become useless.[350] This means mandating registration of all COTS-UASs starting from a certain category, which is exactly what Europe is doing by requiring all craft of above 250 g to be registered. However, even if such a database was in place, one would need to solve the attribution problem to be able to enforce this system. The UASs used by ROC and ROC-Light operators are already registered by law; what is needed is that the *other users* of UAS can also be identified and have their acts attributed to them.

4.3 SQ 3: What influenced Dutch regulators in their decisions concerning COTS-UASs?

In reading the following, bear in mind the tools for assessing connectedness discussed in Chapter 2 as this will enable the reader to be more informed concerning the connectedness of Dutch regulations.

4.3.1 The RDC's research and its influence on the regulatory process

In early white papers Dutch regulators mentioned that the RDC's research had a significant influence on the early stages of the regulatory process.[351] Due to the RDC's research, it was deemed necessary to develop specific regulations for COTS-UASs.[352] Furthermore, it was concluded that the number of research and testing facilities for COTS-UASs needed to be increased. This was deemed important to facilitate innovation intended to provide economic benefits and to develop safe ways of

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[346] Mommers, *Masterwork Transcription Document*, 141.
[347] The Human Environment and Transport Inspectorate*, Voorvallen met drones/RPAS*, ABL July 2016.; The Human Environment and Transport Inspectorate, *Voorvallen met recreatieve en*, ABL June 2017. Nederlandse Omroep Stichting, *Ook Nederland bezorgd*.
[348] Mommers, *Masterwork Transcription Document*, 123.
[349] Ibid., 134.
[350] Ibid., 134.
[351] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 28*. 1
[352] Ibid., 2-3.

testing UASs.[353] Later, a greater number of facilities would allow more data and insights to be obtained regarding the nature of UAS operations, as well as more accurate information concerning safety issues.

Clearly, both safety and security issues were identified early in the response process. The RDC's document also ensured that regulators were well aware of the plurality of parties involved, their respective interests, and the various S&S challenges. Furthermore, the RDC identified a need for both physical and non-physical infrastructure that could aid the COTS-UAS sector to promote transparency and immunization.[354]

The research conducted by the RDC recognized both the opportunities and threats that the proliferation of COTS-UASs presented.[355] This document mapped several potential threats associated with criminal and terrorist use of UASs.[356] These include the delivery of harmful payloads, causing panic without a payload, crashing directly into targets, and the trafficking of illicit goods.[357] Therefore, known regulators were aware of the possibility of both criminal and terrorist uses of drones at the start of the regulatory process.

4.3.2 The initial assumption concerning professional versus recreational use and the RDC's research

The 2015 RDC report states that they expected an increase in the rate of COTS-UAS proliferation to occur specifically due to users wishing to use drones to make money.[358] This influenced regulators to focus on professional user of COTS-UASs, as opposed to recreational users, during the initial stages of the regulatory process.[359] This assumption, which would later prove to be incorrect, had a direct influence on the response process.[360]

However, this bias arose, during the early stage of the regulation process, because regulators assumed that professional users would seek to test the limits of what was possible with COTS-UASs.[361] The interviewees also stated that this assumption against professional users was due to the expectation that professionals would want to operate at the edge of what the regulations would allow. This assumption ultimately proved unfounded, as most safety issues would arise due to uninformed or unconcerned recreational users.[362] Furthermore, the individuals responsible for the majority of incidents would be recreational users who were also *not* members of traditional model aircraft associations.[363] In time, this bias towards professional users was corrected, and the professional ruleset improved as data became available.

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[353] Ibid., 4..
[354] Custers et al., *Het gebruik van drones,* 154.
[355] Ibid., 158-159.
[356] Ibid., 69.
[357] Ibid., 69.
[358] Ibid., 85-86.
[359] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 28*, 7.
[360] Ibid., 2-3, 5, 7.
[361] Mommers, *Masterwork Transcription Document*, 117-119.
[362] Ibid., 117.
[363] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 28*, 4.

4.3.3 The RDC research, public safety, and economic integration

Two issues were paramount for Dutch regulators: First, they wished to ensure public safety. [364] Second, they intended to encourage the economic integration of (COTS)-UASs to ensure that the Netherlands would benefit from the use of such systems. The white papers show a clear intent on the part of both the House of Representatives and regulators to facilitate innovation and benefit from the economic gains offered by the integration of COTS-UASs into Dutch society. This pursuit of economic integration led regulators to make professional use of COTS-UAS possible without the need for an exemption from the MIWM's Inspectorate.

The exploratory RDC research gave the Netherlands an adequate basis upon which to start adapting its regulations.[365] The RDC identified a clear need to update Dutch regulations, particularly to ensure that COTS-UASs conformed to technical standards, that pilots demonstrated their capabilities through completing the certification process, and that recreational users would be informed of the risks and responsibilities associated with COTS-UAS operation.[366] Finally, the RDC's research also noted that the ongoing proliferation of COTS-UASs would make the administrative cost of the early regulatory system excessive.[367] Finally, the early 2015 regulatory system was deemed overly complex by involved actors and stakeholders, a stance that was supported by the RDC.[368]

4.3.4 2015–2018: Overall influences on the decisions made concerning the professional and recreational rulesets

The following points highlight a trend in the Dutch regulatory response, namely that, to increase the connectedness between the regulations and COTS-UASs, regulators increased the possibilities in terms of professional use while attempting to further restrict recreational use.

-July 1st 2015:

The professional use of drones was made possible by the introduction of the ROC.[369] Because of the positive economic and social opportunities for both the public and the private sectors offered by the professional use of COTS-UASs, it was decided to make operating such systems easier.[370] Previously, professional use was only possible through being granted an exemption by the HETI. The ROC's creation signifies increasing connectedness with new (necessary) rules.

-July 1st 2015:

July also saw the introduction of new regulatory restrictions on all model aircraft, including a lower maximum altitude of 120 m (as opposed to the previous 300 m) when not flying at designated model aircraft associations.[371] This decision was influenced by the desire to keep COTS-UASs separate from manned aviation due to fear of mid-air collisions. As will be explained later on, applying model aircraft regulation to COTS-UASs was a form of over-inclusion and therefore disconnectedness.

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[364] IENW, Voortgangsbrief Drones 28 Mei 2018, 1.
[365] Elands et al., *Technical Aspects Concerning*, 12.
[366] Custers et al., *Het gebruik van drones*, 14.
[367] Ibid.
[368] Ibid., 94.
[369] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 31*, 3.
[370] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 28*, 1.
[371] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 31*, 3.

-July 1st 2016:

-July 2016 marked the introduction of the mini-drones ruleset, creating the ROC-Light.[372]
-Therefore, regulators lightened administrative obstacles to professional use of drones of up to 4 kg.
-Regulators eliminated the notice to airmen (NOTAM) requirement for professional use of drones of up to 4 kg. A NOTAM communicates what type of aviation is taking place at a specific time, location, and height, which can in turn restrict other aircraft from entering the airspace in question.[373] These measures were deemed too strict for professional use of smaller COTS-UASs (i.e., those under the 4-kg weight limit).[374] With the introduction of the ROC-Light, the Netherlands differentiated between three types of users: two professional types and recreational users.
These measures signify increasing connectedness due to obsolete rules being removed and rules being introduced in order to increase connectedness to the reality of professional use of drones under 4kg.

- October 4th 2017:

In 2017, restrictions on ROC holders were reduced by providing them with more options with regard to flying in CTRs.[375] This was done after tests concluded that this change could be implemented safely.[376] Professional users would also no longer have to give the previously required 24-hour notice to a mayor, and the number of areas in which a 48-hour in-advance NOTAM was required were reduced.[377] In addition, the proximity restrictions on ROC holders were lowered by regulators.[378] These changes were made based on consultations with industry actors, as a result of which it was concluded that these requirements were unnecessary. This signifies greater connectedness due to the elimination of obsolete rules and updating existing rules to increase the fit between regulations and the reality of professional drone operations. In line with the identified solutions to emergent technology governance challenges, and COTS-UASs public safety concerns, regulators placed additional emphasis on the importance of the weight of the UASs in formulating regulations, the need to be able to enforce said regulations, and the importance of coordination between those responsible for enforcing the regulations.[379]

-September 11th 2018:

On this date, the responsibility for regulating all aircraft was officially shifted to the European level.[380] Because of this shift, separate rulesets for traditional model aircraft flyers and recreational COTS-UASs were not implemented despite the identification of safety issues associated with the recreational ruleset, and the drafting of new regulations concerning recreational use of UASs in 2016 and 2017.[381] Therefore, the gap with regard to recreational regulations was not addressed due to the SRRE. This signifies that the identified response gap was not addressed due to challenges associated with cosmopolitan technology

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[372] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 36*, 5-6.
[373] De Jager, *Wat is een NOTAM?*; Mommers, *Masterwork Transcription Document,* 75.
[374] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 36*, 6.
[375] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 46*, 7
[376] Dijksma, *Regeling van de Staatsecretaris 4 oktober 2017*, 4.
[377] Kamerstuk 30806, 39, 2017, 5 April, 1.
[378] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 46*, 6.; Dijksma, *Regeling van de Staatsecretaris 4 oktober 2017,* 5.; Gordts, *ROC-houders mogen nu*.
[379] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 39*, 2.
[380] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR*. 48, 8.
[381] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 46*, 7-8.

regulation. To understand the influence of European regulations on the decisions of Dutch regulators, the following issues are paramount.

4.3.5 Forgoing updates to the recreational ruleset: the role of the regulatory interim and the SRRE

Regulations intended to reduce the gap between the recreational and professional rulesets were intended to go into effect in 2017.[382] Regulators wished to reduce the differences between the recreational ruleset, and the ROC-L, in 2017 due to the discrepancies between the recreational and professional rulesets.[383] Discrepancies such as the fact that ROC-L holders had higher levels of airmanship but were also subject to more stringent proximity and weight restrictions than the recreational users. However, the oncoming European regulations do not differentiate between types of use but instead categorize all types of drone operations, regardless if the purpose being profit or recreation, on the basis of their risk to public safety. This made implementing separate rulesets for traditional model aircraft and recreational UASs in the Netherlands inefficient, particularly because European regulations will do away with the difference between types of use.[384]

Further national updates were not implemented so the Netherlands could start conforming to these oncoming European regulations from EASA.[385] The following changes were therefore not implemented: a reduction of recreational users' maximum flight height from 120 to 50 m and establishing a maximum horizontal distance of 100 m from the operator and a mandatory 50 m distance from infrastructure, people, and crowds.[386] Such an update to the recreational ruleset would have addressed the extensively discussed discrepancies between the professional and recreational ruleset. The aforementioned situation signifies that a major influence on the Dutch regulatory response to COTS-UASs were cosmopolitan challenges as a result of the SRRE. The drafted updates to Dutch regulations were then not implemented because this would be time and resource inefficient because of how short they would be in effect until European regulations.

4.4 SQ 4: What regulatory measures aid (or could aid) in ensuring that Dutch society benefits from the advantages offered by the adoption of this technology?

Public acceptance of COTS-UASs relies on the public trusting that their safety, security, and privacy will be assured. The ability of COTS-UASs to contribute in a meaningful way to safety has been recognized by regulators.[387] As the technology progresses, COTS-UASs will become increasingly reliable and include more safety-by-design features. Based on the interviews, public acceptance can be increased in the following ways.

First, regulation needs to support the creation of (physical and digital) infrastructure that facilitates the integration of UASs. Such infrastructure would be similar to that associated with automobiles or manned aviation; the importance of this point was noted in the RDC's research and the interviews. Combining infrastructure dedicated to UASs with regulations that mandate complementary

382 Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 39*, 2.
383 Ibid.
384 Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 46*, 7.
385 Ibid.
386 Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 39*, 1.
387 Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 46*, 3.

safety-and-security-by-design features in COTS-UASs will dramatically increase transparency, attribution, and oversight and thus enable enforcement. Illegal use of COTS-UASs by uncertified users, and a few rogue ROC-Light users, was possible due to the identified transparency, attribution and enforcement problems. Finally, public safety can also be increased as a result of the implementation of a separate designated layer of airspace for UASs This will also provide clarity for the sector with regard to UAS operations and separate manned and unmanned aviation.

4.4.1 Transparency, privacy, and public acceptance

In terms of facilitating public acceptance of drones, ensuring that privacy-by-design features are implemented in COTS-UASs is important.[388] For example, as a result of developments in the field of facial recognition software, COTS-UASs can automatically ensure the anonymity of recorded individuals.[389] Other design features can ensure that an operator first needs permission to turn on his cameras in particularly sensitive areas.[390] Ensuring privacy by design will become increasingly important, as UASs are consistently improving in terms of their visual range and accuracy, while people on the ground might not even be aware that they are being filmed.[391]

It is important for both public safety and the public image of COTS-UASs to allow individual citizens transparency concerning UAS operations taking place in their vicinity.[392] This can be achieved through smartphones apps based on appropriate databases that will allow ongoing operations to be identified in real time.[393] Ensuring that UAS operations are transparent to members of the public will not only improve public safety but also counter any unease that people may experience when they see a UAS.[394] Finally, this will also increase security because UAS that cannot be identified through these systems can then be reported to police.

Furthermore, to improve public acceptance of COTS-UASs the identified ambiguity in Dutch regulations can be addressed. The interviewees stated that the general public often found the regulations on COTS-UASs to be unclear and confusing. However, the interviewees also made a critical observation; with due diligence and effort, the rules can be understood and should be followed.

As a solution for such issues, with the oncoming European regulations, the creation of a single entity to which citizens and business could go with all of their questions concerning the impending European regulations was suggested.[395] This suggestion is similar to that made by Marchant and Wallach concerning the creation of a GCC.

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[388] Mommers, *Masterwork Transcription Document*, 10.
[389] Ibid., 12.
[390] Ibid., 10.
[391] Ibid., 19.
[392] Ibid., 19-20.
[393] Ibid., 19.
[394] Ibid., 20.
[395] Ibid., 62.

4.5. SQ 5: How can regulations aid in protecting against COTS-UAS-related security issues?

Both in terms of S&S issues, solutions were predominately found (in both the white papers and the interviews) in working *with*, instead of *against,* the technology of (COTS)-UASs. Specifically, by increasing levels of transparency and attribution for public safety and in support of I&P efforts against terrorists. These statements reflect the use of *regulatory countermeasure*s to security as described in Chapter 1. The technological development of COTS-UASs therefore presents more opportunities for increasing transparency and immunization than threats of evasion. Because this enables design-in and design-out of desired or undesired behavior with COTS-UASs.

Based on the interviews, it was determined that the most significant gains are to be found on the transparency side of the deterrence equation. Although immunization measures serve a purpose immunization measures are subject to the displacement effect. Whereas as transparency increases, enforcement becomes easier due to the solving of Geis and Hailes' attribution problem. The actual punishment of transgressions involving COTS-UASs is expected to further regulate behavior; this is due to the fact that knowing that the likelihood of being caught is high and that the punishment will be severe is likely to have a deterring effect on illegal COTS-UAS use. This is due to the fact that using COTS-UASs in unintended ways would then require additional effort and specific knowledge (in order to circumvent these features). Security-by-design features can then make engaging in unwanted behavior more difficult and expensive.

4.5.1 Transparency and immunization for security

Throughout the interviews, there was a consensus regarding transparency being more beneficial in terms of ensuring S&S with regard to UASs than immunization. The interviewees also supported the view that I&P efforts may prove more beneficial in terms of addressing terrorism issues than HS efforts. Interviewees with knowledge related to the subject of terrorists using COTS-UASs stated that the most gains are to be had investing in existing intelligence and surveillance efforts alongside de-radicalization or reconciliation efforts. Therefore, alongside support for I&P there was recognition for the overall importance of the Conciliation and Dialogue approach. Furthermore, military experts recommended investing in I&P efforts for domestic security and focusing on denying access to, and transport of, COTS-UASs in conflict zones.

4.5.2 The issue of the displacement effect and why it makes immunization efforts less attractive

Many of the interviewees expressed support for Jackson's argument concerning the displacement effect. If the Netherlands were to start placing short-range air defense systems (SHORADS) around certain locations, terrorists may simply shift their targets.[396] Regardless of the target, I&P efforts focus on identifying who is trying to achieve harm in the first place. What can aid I&P efforts is the implementation of regulations increasing transparency into COTS-UASs through registration and features enabling in-air detection and attribution. Finally, in ensuring domestic security, it is undesirable to deploy kinetic countermeasures due to the remaining potential for public harm because the hostile UAS in question, or its payload, will still crash.[397]

However, immunization is still valuable, and the development of appropriate countermeasures is important in dealing with the full spectrum of UAS threats. The main advantage to be gained, however,

[396] Ibid., 90.
[397] Ibid., 32, 33, 79.

lies in developing appropriate regulations in cooperation with the UAS industry that ensure inherent S&S by design. Active/passive countermeasures can then serve to deal with home-made UASs or black market systems that do not conform to established regulations. Finally, security-by-design features can enable active/passive countermeasures to be (more) effective in dealing with COTS-UASs.

4.5.3 By design features for detecting COTS-UASs

From the well-known radio frequency identification (RFID) chips to the automatic dependency surveillance broadcast transponders (ADSB), there are several technologies that can be installed in UASs to increase transparency. Such technologies can then broadcast information about a UAS, its operator, and its current operation, which will promote airspace transparency. Such measures can also help to identify and discriminate between UASs operating either legally or illegally. In addition, there are even ways of analyzing the uplink and downlink between a UAS and the operator's controller. Such signals can be tagged and traced, but doing so is not as easy or convenient as requiring that UASs have pre-installed identification technologies.

In terms of financial costs, the ADSB transponder is very cheap (less than a single euro), which allows it to be installed in even the smallest types of COTS-UASs.[398]However, there is the caveat that such detection systems should not cause clutter for manned aviation. The aforementioned measures also help in identifying non-cooperative UASs which goes back to the need for multiple, layered systems of identification.

4.5.4 Requirements for transparency: registration and detection systems

As COTS-UASs have developed, more technologies that aid in ensuring S&S have become available, but these need to be made mandatory through regulation.[399] In this regard, regulators stated that the registration of COTS-UASs alone was not helpful to safety because transgressing COTS-UASs need to be identifiable and traceable while in the air.[400] However, registration of COTS-UASs is still of use for liability and insurance purposes.[401] Instead, detecting, tracking, and identifying the direct users of COTS-UASs was deemed necessary to address safety *and* security concerns.[402]

4.6 SQ 6: How does the technological development of COTS-UASs increase the capacity of criminals and terrorists?

The MiJS views UASs as being both a beneficial technology for the Netherlands and helpful in terms of fulfilling its responsibilities in ensuring the safety and security of Dutch society. Drones aid the Ministry through operations involving fire-fighting, detection and surveillance, inspection of important infrastructure, search and rescue, and police work.[403] However, UASs also pose challenges to the Ministry due to precedents in terms of criminals trafficking illicit goods into prisons and their potential for eavesdropping. The latter, referring to obtaining information through audio, video, or electronic means for illicit purposes through use of COTS-UASs.

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[398] Ibid. 124.
[399] Voortgangsbrief Drones, 2018, 3.
[400] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 39*, 3.; Mommers, *Masterwork Transcription Document*, 134.
[401] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 39,* 3.
[402] Ibid.
[403] Mommers, *Masterwork Transcription Document*, 24.

The interviewed experts who were familiar with the use of COTS-UASs in conflict zones deemed the surveillance capabilities that COTS-UAS offer as a *new* addition to the capabilities of criminals and terrorists. This supports the idea that increased aerial reconnaissance and surveillance capabilities are more of a novel paradigm than the use of UASs to deliver hostile payloads. This is especially the case because, as interviewees agreed, there are many other, arguably more effective, means of delivering much larger payloads. However, those interviewees who were familiar with the use of COTS-UASs by terrorists did feel that these systems were used more frequently, and in more creative ways, in conflict zones.[404]

Interviewees agreed that, economic disruption caused by unidentified UASs, whether intentional or unintentional, may be the most damaging use of a COTS-UAS, when compared to the effort required; as this does not even require a payload.[405] One can consider the recent incident at Gatwick Airport for a real-world example of such an event.[406] Either intentional or negligent use of UASs around airports can cause great financial loss and social disruption among those either directly or indirectly affected due to an airport's cross-border nature. This is in line with the view that UASs can cause disproportionate economic damage relative to their cost and the effort required to engage in disruptive activities. Thus, if the focus is on gaining attention and societal disruption, using a drone without a payload to shutdown airports is the "better" choice for a hostile actor.

Although the concept of flying bombs is worrying, and although an increase in the hostile use of COTS-UASs to deliver payloads was recognized, the new surveillance capabilities that such systems offer to criminals and terrorists were considered to be the only actual revolution. Aerial surveillance is a new capability; in contrast, delivering payloads by means of COTS-UASs, while considered a realistic threat, was regarded as simply another tool for the same type of job. However, the aerial nature of UASs does increase the reach of wrongdoers in terms of their available options and possible targets i.e. they may be able to get to places they otherwise could not access. By comparison, aerial surveillance and reconnaissance capabilities represent a new contribution to terrorists' toolboxes.

Although using COTS-UASs to deliver contraband or payloads, may increase the range of operations that can be conducted by terrorists, it does not constitute a new paradigm. Still, interviewees recognized that the development of COTS-UASs' capabilities tilt the deterrence equation in favor of criminals, including terrorists. However, the technological development of UAS actually presents more opportunities to mandate S&S-by-design features, in order to balance the deterrence equation.

4.7 SQ 7: Is there a bias on the part of either actors or researchers towards viewing COTS-UAS technology from a perspective that focuses on terrorism, and, if so, does this bias influence the regulatory response?

As a result of an excessive focus on the (admittedly realistic) threat of drones being used to deliver payloads, other, more impactful acts may receive insufficient attention. Because, if the focus on hostile delivery of payloads with COTS-UASs leads to investments in immunization, the necessary means of transparency might not develop fast enough. The interviewees deemed terrorism involving COTS-UASs a serious and relevant, but overall manageable, threat. However, they considered it one that

[404] Ibid., 87-88.
[405] Ibid., 25.
[406] De Jager, *Weer beperkt vliegverkeer Gatwick*.

currently overshadows many other threats and unjustly detracts from the many positive uses of COTS-UASs, particularly when the media frames the terrorist use of such systems in a sensationalist manner.[407]

The Dutch UAS sector encountered problems not only due to how drones have been used in recent wars but also due to a media bias towards depicting harmful use of COTS-UASs.[408] Both the interviewed regulators and actors and stakeholders from the UAS sector criticized this unhelpful focus on terrorist use of COTS-UASs. One particular example from the interviews: when considering the perceived threat of UASs being used to drop toxins into water supply infrastructure, one could more easily transport a greater quantity of such toxins to such a location by foot.[409] Therefore, conducting the same operation by foot would be far more effective, and even stealthier, when one considers the noise that contemporary COTS-UASs make. From this perspective, the terrorist threat with regard to COTS-UASs has been exaggerated.[410] This is because many of the discussed threats by use of COTS-UASs can be performed in a more efficient and easier manner by other means. However, the concept of an airborne threat is used to draw people's attention.

Furthermore, many more effective means of delivering heavier payloads exist, such as cars, trucks, or even package services, and regulators have not chosen to ban these. As with the internet, the commercial airplane, and the freight truck, this benign technology may also be employed for crime. However, this should not lead to this technology being treated differently based on a connection to terrorism. Finally, such a framing of COTS-UASs negatively impacts the image of the UAS sector. A particular example of this is when the Dutch media believed that a conference concerning the beneficial uses of COTS-UASs in the Netherlands revolved around discussing the use of military drones to perform targeted killings.[411]

Likewise, there has been a negative impact on the public's perception of the Dutch Air Force's use of drones. This is due to the way in which UASs have been used by American forces.[412] This is particularly unfair given that the Dutch military's doctrine differs significantly from that of the United States and that the Dutch armed forces do not currently use drones for targeted killings.[413] However, the focus on targeted killings with UASs by other militaries led to issues for the Dutch military in obtaining its own UASs and to inaccurate assumptions on how the Dutch air force actually uses them.

4.8 SQ 8 How can the Netherlands use or regulate COTS-UASs to ensure its own security?

The interviewees supported the following statements: Security can be promoted through the inclusion of safety- and security-by-design features. These features can facilitate deterrence by denial of resources, lowering the chances of success of unwanted acts, and increasing the costs necessary to achieve success in unwanted acts. Safety and security features bring balance to the situation discussed in Chapter 2, namely that detecting COTS-UASs and enforcing the relevant regulations is expensive and difficult, while engaging in unwanted acts with COTS-UASs is cheap and easy. Furthermore, as COTS-UASs technology develops, the options in terms of enabling transparency and attribution will only increase.

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[407] Mommers, *Masterwork Transcription Document*, 54-55, 57-58, 22.
[408] Ibid., 121.
[409] Ibid., 138-139.
[410] Ibid., 139.
[411] Ibid., 121.
[412] Ibid., 96-97.
[413] Ibid.

However, enabling transparency and immunization depends on the implementation of regulations. Meanwhile, increasing transparency will greatly aid in preventing the economically significant disruption of major airfields. To increase transparency, measures such as UTMs need to be put into place, and regulations requiring that COTS-UASs incorporate devices that make the identification of such drones easier should be implemented.

The interviewed experts identified deterrence by denial as the best approach for addressing both domestic COTS-UAS-related security issues and the use of such systems in foreign conflicts, both in terms of the I&P approach and by denial of resources. For domestic security, active (kinetic) countermeasures were not considered the best solution to the hostile use of drones due to the fact that potential payloads should be disposed of in a controlled manner at a safe location. Therefore, countermeasures that result in a UAS crashing are less desirable due to the fact that they do not address the controlled landing issue.

In conflict zones, short-range air defenses (active countermeasures) serve to counter current use of COTS-UASs. However, over the long-term, the interviewed experts deemed it better to focus on denying enemies the resource of COTS-UASs. This is particularly relevant when one considers how expensive SHORADS are when compared to COTS-UASs. This contributes to the debate on how non-state actors can cheaply provoke expensive reactions on the part of states through the use of COTS-UASs.[414] This practice represents a form of hybrid warfare through the use of COTS-UASs.[415]

Active and passive countermeasures are likely to remain a useful tool for increasing security and promoting deterrence. No matter how well safety- and security-by-design features are implemented, there will always be a need for countermeasures to deal with self-built or black market UASs. Electronic and cyberwarfare options are of particular importance because these passive countermeasures allow for drones to be disposed of in a controlled manner and can engage multiple drones simultaneously.

4.8.1 Using UASs for security: counter-drones and their arms race considerations

Drones that combat other UASs have a niche, but they also represent an arms race issue. Adamson stated that when we arm ourselves, we, in due time, also arm our enemies.[416] The use of counter-drones as the main security measure represent an arms race issue that is likely to accelerate development of UASs' ability to evade or combat other drones. The technology that will enable counter-drones to outmaneuver hostile drones will eventually be implementable by hostile actors, which is at the core of the arms race issue.

Drone-catchers, meaning UASs that can intercept and transport hostile drones to a safe location, fill the niche role of disposing of hostile drones in a controlled manner. However, interviewed experts stated that should counter-drones be relied upon excessively, they are likely to become a clear threat that opponents may bypass, meaning that they will develop measures or drones specifically intended to bypass deployed counter-drones.

Overall, counter-drones were a contested issue; some viewed them as having a valuable place in the security toolbox, while others questioned their usefulness or arms race potential. The need to control where a UASs lands can be satisfied by the use of counter-drones in combination with electronic

[414] Rassler, *Remotely Piloted Innovation*, 33.; Rassler, *The Islamic State Drones*, 1, 24.
[415] Rassler, *The Islamic State Drones*, V.
[416] Adamson, *Ethical Challenges Future Technologists*, 4.

warfare. However, too much reliance on counter-drones was seen as an risking an arms-race between counter-drones and hostile COTS-UASs.

4.9 SQ9 What forms of countermeasures are useful in countering unwanted behavior involving COTS-UASs in the Netherlands?

The representative from the MiJS provided the following insights. The MiJS has focused, through cooperation with multiple parties with various types of expertise, on developing means to detect UASs and countermeasures.[417] This led to several options with regard to responding to security issues. Means of detection include acoustic and electronic systems that were specifically co-developed with the government and industry actors and stakeholders to detect UASs. Examples include further development of radar systems (initially intended for the detection of birds) and an acoustic system that listens for and detects the distinct sounds that UASs make. Military systems are also effective means of detection, but they are far too costly for civilian actors (e.g., Schiphol Airport). The expense of military equipment led to the development of separate more cost-effective systems focused on detecting UASs.

The interviewees provided much support for the adoption of Jackson's I&P approach in countering security-related issues involving drones. While the HS approach was deemed useful as a complement to I&P, the interviewed members of the military emphasized the importance of denying terrorists use of COTS-UASs in the first place and the role the displacement effect plays in making HS less effective.

Interviewees supported that denial of resources can prevent the use of or even access to COTS-UASs altogether, for example by disrupting the supply routes that are used to transport COTS-UASs to active war zones. While the black market and self-built drones will still be an issue, security-by-design features mandated by regulation will make it more difficult and expensive to use COTS-UASs for hostile purposes. Therefore, addressing future security issues associated with emergent technology begins with considering how such technologies enter the market. Security-by-design features are then a form of regulatory countermeasures meant to increase deterrence.

4.9.1 Countermeasures developed in the Netherlands.

During the period in which Dutch institutions were still researching and developing means of countering UASs, they employed a creative temporary solution. Government agents trained birds of prey to intercept trespassing drones in 2016 and 2017. However, this solution was unsustainable due to the associated costs and the rate of development of UAS technology.[418]

Dutch regulators have invested heavily in the research and development of security measures. However, there has not been a confirmed intentional security threat involving a COTS-UAS in the Netherlands.[419] Therefore, it is difficult for regulators to justify further investments in developing security measures, particularly given the detection systems that the Netherlands already has at its disposal and is still developing.[420] Furthermore, detecting trespassing UAS has proven to be an effective deterrent on its own signifying the effect of transparency.[421] Lastly, the Netherlands already has several active and

[417] Mommers, *Masterwork Transcription Document*, 25, 109.
[418] Ibid., 125.; Landelijke Eenheid Politie, *Politie stopt met*.
[419] Mommers, *Masterwork Transcription Document*, 33-34.
[420] Ibid., 32, 124.
[421] Ibid., 25.

passive countermeasures at its disposal with which to with which to effectively address security threats involving COTS-UASs.

A countermeasure developed by the MiJS is that of an electronic pulse. This countermeasure electronically overloads a UAS, a measure that would also be effective in a scenario involving multiple UASs.[422] In addition to electronic countermeasures, the Dutch also have cyberwarfare options that enable the detection of a drone and identification of its direct operator or even taking over control of a drone.[423] Based on the interviews, the greatest benefits are to be obtained through the use of these cyber and electronic countermeasures given the desire to identify, and dispose, hostile drones in a controlled manner. However, limiting factor are the remaining questions concerning the effect electronic countermeasures might have on people's health and the environment.[424]

Finally, geofencing was not considered a sufficiently adequate security measure by interviewed experts.[425] Geofencing is useful in ensuring public safety with regard to the majority of COTS-UAS users.[426] Although useful for general public safety geofencing is not a robust security measure as a drone's components or software can be tampered with to disable geofencing.[427]

4.9.2 Remaining challenges with countermeasures

Despite the current availability of Dutch countermeasures, the ongoing development of countermeasures does not match that of the technology it is intended to counter.[428] First, this is due to the speed at which UAS technology, together with artificial intelligence, imagery recognition, and swarming technology, is developing. The second reason for this comparatively slow development is the greater financial incentives that exist for the private sector to increase the technological capabilities of UASs, as well as the private sector's vast financial resources. Finally, implementing countermeasures on a large scale is its own challenge, as there has thus far been no "business case" concerning hostile COTS-UASs in the Netherlands.[429] Due to a lack of a precedent where such systems would be necessary, it is hard to justify committing further resources to the development of security countermeasures, especially given the options already available to the Netherlands.

Challenges remain in the availability of more affordable countermeasures, because Dutch regulators identified that equipment useful to deal with UAS-related threats is still either "scarce" or "expensive".[430] Significantly, no single system exists that can handle all of the actions necessary for all types of (COTS)-UASs, meaning a single system that can perform "detection, identification, discrimination, [and] tracking" functions and employ appropriate countermeasures depending on the guidance system of a UAS.[431] Currently, it takes several systems to provide all of these functions. Furthermore, no countermeasure system yet exists that can "engage the full spectrum" of UASs in terms

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422 Ibid., 32.
423 Ibid., 29, 32.
424 Ibid., 32.
425 Elands et al., *Technical Aspects Concerning*, 53.
426 Ibid., 44.
427 Rassler, *The Islamic State Drones*, 3.
428 Mommers, *Masterwork Transcription Document*, 33.
429 Ibid., 36: direct quote, therefore, not translated.
430 Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 46*, 6 (my translation).
431 Mommers, *Masterwork Transcription Document,* 75 (my translation), 79.

of detecting and countering all types of guidance systems of COTS-UASs.[432] This is because these separate forms of guidance (which include GPS, wifi, radio, and pre-programming) require the jamming of different signals. When a UAS operates via GPS, it is necessary to jam the GPS signal. However, jamming the GPS signal will do nothing against a UAS operating via wifi. Although with cyberwarfare it is extremely easy to disable local wifi, the necessary equipment has to be present. Finally, the development of available security measures is not progressing at the same rate of the technological development, which entails that a gap will potentially emerge.[433]

Many countermeasures currently on the market focus on disabling platforms on a one-by-one basis, either by electronic/cyber warfare or by the use of nets or projectiles. However, the caveat with many electronic warfare measures is that when signals are jammed, significant parts of the Dutch infrastructure are also jammed. For example, consider the danger of jamming signals near airports. In addition it was frequently noted during the interviews that a pre-programmed drone is not vulnerable to many electronic warfare measures. Such a drone will automatically take off at X point in time, fly in a certain direction for an arbitrary period of time at a certain power output, and then will land or keep hovering. Of course, such drones do not fly with the precision granted by the use of GPS or other forms of guidance. This makes using them in this manner troublesome and inaccurate, but not impossible.

In addition, the tendency of government programs to adopt X amount of systems for Y amount of years now results in that selected technology is outdated by the time it is put into use.[434] The Dutch military is developing a method to deal with this lengthy implementation process. Specifically, by creating a method by which new, pre-tested technologies can be bought from a curated catalogue without long-term financial commitment. This catalogue method is promising and would allow the military to be more flexible and cost-efficient in its technology usage. Through use of this catalogue method both civilian and military processes can adapt to the R&A of technological developments.

[432] Ibid., 75 (my translation).
[433] Ibid., 33.
[434] Ibid., 82-83.

Chapter 5: Analysis and Discussion

5.1 The Dutch case in relation to the challenges associated with emergent technology and solutions thereto

5.1.1 The role of multiple regulators, actors, and stakeholders

The importance of the inclusion of actors and stakeholders, which was identified in Chapter 2, was reflected in the white papers from 2015 to 2018. Even in 2015, regulators were aware of the need to communicate with citizens, actors, and stakeholders concerning UAS regulation.[435] Regulators addressed UAS-related issues while staying in regular contact with the UAS sector and relevant stakeholders and while fostering R&D, the expansion of testing facilities, experiments, and the overall UAS sector. [436] To effect, regulators held multiple meetings per year with actors and stakeholders concerning UAS-related topics and the role of regulation.[437]

Many of the interviewees also participated in these meetings. These meetings included other regulators and representatives of other ministries, the military, Dutch research institutions, businessmen, and UASs actors and stakeholders. These meetings signify that the Dutch regulatory response included coordination and communication between regulators, actors, and stakeholders as discussed by Marchant and Wallach. Furthermore, that in the terms used by Clarke and Moses: formal regulation was complemented by co-regulation in the Netherlands.

5.1.2 The application of older perspectives

The concerns identified in Chapter 2 regarding manned aviation thinking and regulations being applied to unmanned aviation proved valid with regard to the Dutch case. Established manned aviation methods were applied to UASs, resulting in an imbalance between regulation and the reality of unmanned aviation. Simple UAS operations were then subject to complicated requirements that, while suitable for manned aviation, were disproportionate or ineffective for UAS.

COTS-UAS-related issues should therefore be approached from new perspectives, and the government should invest in individuals who have specific knowledge and experience of the subject of unmanned aviation.[438] These approaches are particularly important given the reality of UAS operations differing so greatly from that of manned aviation, and the over-inclusion of COTS-UASs into model aircraft regulations.

5.1.2 Cosmopolitan challenges

The results indicate that the process of addressing regulatory gaps in terms of public safety was complicated by the need to shift from national-level to European-level COTS-UASs regulations. The interval between SRRE therefore prevented higher levels of transparency and immunization from being achieved in the Netherlands on a local basis.

The European framework, like the Dutch MIWM, identifies the need for transparency, which is, to be achieved by implementing a uniform UTM system throughout Europe. Furthermore, by making

[435] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR*. 28, 3.
[436] Mommers, *Masterwork Transcription Document,* 108.
[437] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 36*, 2.
[438] Mommers, *Masterwork Transcription Document*, 83.

identification measures mandatory for UAS above 250 g in weight.[439] When the European regulations come into effect, the Dutch UAS sector will have clearer regulations on which to base investments, and it will also be possible to conduct UAS operations internationally. The ability for UAS businesses to operate internationally is vital to the growth of the sector and for the implementation of UTMs intended to provide greater transparency. Real benefits can result from the implementation of UTMs and safety- and security-by-design features on the European level. This is particularly the case because the Dutch COTS-UAS market is too small to influence the industry to implement S&S features.

In comparing the risk-based approach of EASA to the Dutch rule-based approach the following is concluded. Instead of the Dutch focus on the operator's intention of use, the EASA framework differentiates between types of operations based on their corresponding risk regardless of whether it is recreational or professional.[440] This approach leaves less room for ambiguity than the Dutch regulations, where having to determine an operator's intent led to problems in oversight and enforcement. However, the experience gained by Dutch regulators with regard to the ROC and ROC-Light system influenced the way in which the European regulations now categorize drone operations. Meaning, the success of the Dutch professional rulesets, in enabling professional use quickly and safely after the proliferation of COTS-UASs, has been taken into consideration by those responsible for creating the impending European regulations.[441] Because, European regulators benefitted from the lessons learned in the Netherlands when formulating the "open" European category of UAS operations.[442] In Germany, local regulation of COTS-UASs also benefitted from the experience of Dutch regulators.[443]

However, regulators' inability to subsequently correct the recreational ruleset is an example of how response gaps can occur/remain as a result of cosmopolitan challenges associated with the SRRE. This issue was among the larger response gaps that arose due to the application of pre-existing model aircraft regulations to COTS-UASs.

5.2 Assessing the Dutch regulatory response

5.2.1 Assessing connectedness

As shown in Chapter 4, Dutch regulators sought to improve connectedness of both the professional and recreational regulations related to COTS-UASs. In 2015, professional use of drones was made possible. However, even the MIWM acknowledged that the professional ruleset still is a less-than-ideal solution in 2018.[444] It was stated that if regulators would have had the opportunity to create regulations completely separate from those that apply to manned aviation, the regime for UAS would have been superior.[445]

Still, the Dutch professional ruleset allowed the sector to begin operating and has been updated over the years. This approach made professional use possible and went on to better reflect the reality of unmanned aviation as more data became available.

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[439] European Aviation Safety Agency, Opinion no 01/2018 Annex, 5.
[440] Ibid., 1.
[441] Mommers, *Masterwork Transcription Document*, 55, 133.
[442] Ibid., 133.
[443] Ibid., 143.
[444] Ibid., 142-143.
[445] Ibid., 143-144.

5.2.1.1 Signs of connectedness

As an example of improvements in terms of connectedness Dutch regulators recognized "The need for special rules to deal with a new situation". [446] This is evident from the new regulations introduced between 2015–2018, as well as the ROC and ROC-L professional rulesets. Dutch regulators eliminated obsolete rules for professional users, such as the transponder and the NOTAM requirements, and reduced proximity restrictions, as it became clear that various COTS-UASs could fly closer without compromising public safety. Therefore, in terms of regulations for professional use, there has been an upwards trend in terms of connectedness over the years. Finally, the early professional ruleset was overly restrictive due to the assumption that professional users would be responsible for the most safety issues. This assumption proved untrue and in turn restrictions on professional use that could no longer be justified were removed when data proved these had become obsolete. Based on the interviewees stating that the professional ruleset ensures public safety, and that future gains lie in improving the technical nature of COTS-UAS, and data collected by regulators supporting this, the current professional ruleset is deemed connected to the reality of COTS-UAS in 2018.

The MIWM's inspectorate certifying the airworthiness of individual COTS-UASs will become cost-ineffective as professional use increases. However, these efforts of the ministry and its inspectorate are a positive sign of connectedness because this facilitated the safe professional use of COTS-UAS during a time where regulation guaranteeing the technical quality of COTS-UASs were not in place. Quality assurance were not in place because these were to be regulated on the European level.

Furthermore, regulators drafted regulation to fix the problem with the over-inclusiveness of recreational COTS-UAS in model aircraft regulations, which would be a positive sign of connectedness. However, these updates were not put into action due to the cosmopolitan challenges of the SRRE. Instead, to ensure higher levels of airmanship in recreational users and to provide clarity in regards to the regulations regulators launched several public information campaigns.

5.2.1.1 Signs of disconnects

A major disconnect between the reality of COTS-UAS and regulations is the Dutch recreational ruleset. The tension between recreational COTS-UASs and traditional model aircraft is a clear case of over inclusiveness of the former into the regulations for model aircraft. The differences between the ways in which COTS-UASs were used when compared to model aircraft led therefore signifies COTS-UASs being over-included in model aircraft regulation. Instead, recreational use of COTS-UASs should have received its own regulations, which should have been separate from those that apply to model aircraft.

The interviewees considered people with little to no airmanship being able to legally fly COTS-UASs of up to 25 kg *next* to crowds and people to be one of the major safety issues in the Netherlands. This was particularly considered to be the case given that, in 2015, the technical quality of UASs was identified as an important factor in ensuring safety, while recreational users were already responsible for the majority of safety issues.[447] In subsequent years, Dutch regulators obtained data showing that most safety issues involve, and are the fault of, uncertified users.[448] In these cases, safety issues mostly

[446] Clarke and Moses, *Public Safety*, 267.
[447] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR*. 28, 5-6.
[448] The Human Environment and Transport Inspectorate*, Voorvallen met drones/RPAS*, ABL July 2016.; The Human Environment and Transport Inspectorate, *Voorvallen met recreatieve en*, ABL June 2017.

occurred due to violation of the maximum flight height or as a result of transgressing into airspace of manned aviation.[449]

5.2.1.2. The disconnect between manned aviation perspectives to COTS-UAS

As a conventional aircraft makes its landing approach, it will descend to a lower altitude. It is important to ensure that conventional aircraft can make a safe and clear descent. However, there is a difference between the outer edges of such an airport's CTR and the inner regions. Regulations could therefore better reflect the reality of UASs and other aircraft operating in the same space at very different heights. Although early attempts to keep COTS-UASs separate from manned aviation are understandable, the extent of Dutch airspace that still denies access to COTS-UASs is excessive. However, there is a trend in the Netherlands of further enabling professional operations in restricted airspace. To conclude with a major cause of disconnects, the early approach of applying manned-aviation perspectives to COTS-UAS, resulted in many regulations that did not reflect the reality of how, and at what height, professional COTS-UASs operate.

5.2.2 Filling in the table from Clarke and Moses: assessing effectiveness

Using the evaluation criteria from Clarke and Moses, it is now possible to evaluate the effectiveness of the Dutch response COTS-UASs issues.

[449] The Human Environment and Transport Inspectorate, *Voorvallen met recreatieve en*, ABL June 2017, 1.

TABLE 06: The filled in table of Criteria for the evaluation of a regulatory regime

Criteria for the evaluation of a regulatory regime
Process • **Clarity of Aims and Requirements** Purposes and obligations are understandable by the parties that are subject to regulations (the regulatees) and to the intended beneficiaries of the regulation The interviewees recognized that the ambiguous and sometimes fragmented nature of Dutch regulations was confusing. However, with due diligence, people could still fulfill their responsibility to inform themselves of the regulations. Furthermore, Dutch regulators clearly considered the importance of ensuring economic integration while ensuring public safety at the beginning of the regulatory process. The regulators also published frequent updates concerning their considerations and motivations. • **Transparency** Development of review processes are open, and requirements are published The Netherlands publicized its research results, provided progress reports on the development of regulations, and communicated its progress both by issuing official reports and through direct communication with actors and stakeholders. • **Participation** All stakeholders are involved and/or represented in development and review processes The interviewees mentioned that representatives of the sector were frequently invited to participate in and incorporated into the regulatory process. Overall, the interviewees were satisfied with the outreach of the Dutch regulators, the cooperation that this resulted in, and the regulators with whom they were currently in contact. • **Reflection of Stakeholder Interests** The needs of beneficiaries are addressed, and the legitimate interests of regulatees reflected Regulators engaged with the sector in order to balance S&S with economic integration. Later during the regulatory process, input from actors and stakeholders directly influenced updates intended to benefit professional use (ROC-light). The importance of stimulating the economic gains offered by COTS-UASs to Dutch regulators, and Dutch society, was repeatedly mentioned in both data sources. However, Dutch regulators were limited in terms of what they could do due to SRRE, the size of the Dutch market, and obstacles/resource constraints in the Dutch regulatory process.
Product • **Comprehensiveness** All relevant aspects are encompassed within a coherent framework A need was identified for a single point of contact that the sector could consult with questions and obtain accurate and up-to-date information: similar to Marchant and Wallach's concept of a GCC. The ambiguity due to the terminology used in both the professional and recreational rulesets led to issues. Currently, information is fragmented, and the clarity of such information is occasionally an issue. In

particular, what operations are allowed, where these can be conducted, and by whom can be difficult for operators to determine.

- **Parsimony**
  The regime is no more onerous or expensive than is justified

The interviewees stated that the professional certification processes are long and expensive due to a shortage of staff in the relevant organizations. However, not a great deal of information related to parsimony was gathered during the research process. What was clear is that regulators encountered constraints in terms of time, the amount of individuals tasked with regulating COTS-UASs, and legal requirements from manned aviation that made updating the recreational ruleset troublesome.

- **Articulation**
  The requirements are sufficiently specific and operationalized to enable effective and efficient implementation by regulatees

The transparency and enforcement problems due to ambiguous terminology in the regulations have been discussed. For recreational use, there was a consensus regarding the regulations not being specific, and strict enough, in terms of its proximity and weight restrictions. In addition, the interviewees agreed that COTS-UASs have been over-included in model aircraft regulations. Solutions to the recreational ruleset were under development in 2016 and 2017, but the SRRE in 2018 prevented implementation.

- **Educative Value**
  Requirements are expressed in explanatory and instructive from, rather than in abstract, discursive prose

Interviews clearly supported the fact that the professional certification process, and related institutions, provided high educative value and ensured airmanship for certified users. Although not part of the regulatory regime, many Dutch businesses and institutions offer educational services on the professional use of COTS-UASs. Regulators made efforts to explain the relevant regulations for both professional and recreational use. This included publishing regulatory updates, the previously mentioned public awareness campaigns, and outreach initiatives.

There were clear efforts to communicate regulations to uncertified COTS-UAS users in the hope of increasing airmanship. These efforts including commercials, special websites, and having the parts of the industry include information documents with the COTS-UASs they sold.

- **Appropriate Generality and Specificity**
  The scope and the requirements are sufficiently general to cover at least reasonable future developments, but sufficiently specific to avoid over-inclusiveness and anomalies.

A caveat to anticipating future developments is that was that autonomous flying is not included in Dutch regulations, while autonomous operations are likely account for the majority of the market in the future. Furthermore, Dutch regulations did not differentiate between experimental and regular UASs which made testing new UASs difficult in the Netherlands. However, the impending EASA regulations do include autonomous operation.

The application of model aircraft regulations to recreational use of COTS-UASs has been extensively discussed as over-inclusiveness of COTS-UASs into older regulation.

Outcomes

- **Oversight**
  Regulated behaviors are subject to monitoring

Monitoring UASs is difficult due to a lack of available personnel and material. In terms of transparency, UTM systems are available, but the need for European uniformity has resulted in no nation-wide system being adopted. Still, some actors do utilize their own air traffic control systems to identify local UASs.
Due to problems with oversight, unsafe behavior on the part of uncertified users remains undeterred, leading to illegal commercial use of COTS-UASs and uninformed flyers violating restricted airspace. Actors in the Dutch UAS sector self-regulate individuals who conduct illegal operations or knowingly violate the ROC-L ruleset. Finally, full ROC holders and their procedures are subject to audits by the HETI.

- **Enforceability**
  Regulated behaviours are subject to enforcement actions, by beneficiaries directly, and by an enforcement agency

Currently, enforcement by the police on trespassing or illegal uses of COTS-UASs is a public safety issue. This occurs due an attribution problem due to the issues with the availability, cost, and effectiveness of means of detecting and capturing COTS-UASs.
In the Dutch UASs sector itself, there is a desire for greater punishment of illegal UAS operations. Uninformed or unconcerned misusers of UASs are a threat to both public safety and the image of the Dutch UASs sector.
Finally, the unfairness of the recreational ruleset to the professional sector, combined with a lack of deterrence of the illegal commercial use of COTS-UASs due to oversight and enforcement issues, has even been recognized by the regulators themselves.

- **Enforcement**
  The enforcement agency has appropriate powers and resources, and uses them in order to achieve compliance

The police did not have access to enough detection equipment with which to address safety violations. Overall, to ensure appropriate oversight and enforcement, more people with specific knowledge of unmanned aviation, appropriate equipment and regulation, and sufficient resources are needed.
The interviewees stated that enforcement of the relevant regulations with regard to operators of transgressing COTS-UASs was problematic; this was further complicated by the fact that enforcement is divided between the regular police and the Police Aviation Service.

- **Review**
  The scheme is reviewed and adapted to ensure that the outcomes correspond to the aims

Overall, the Dutch regulations were reviewed and updated in accordance with the aim of facilitating the economic integration of UASs whilst ensuring public safety. Although the government initially

implemented strict regulations on COTS-UASs professional use was incrementally made easier and more reflective of the reality of UASs developments. Central to these updates to the professional ruleset was better data on safety issues and communication with, and coordination between, other regulators, the military, and UAS actors and stakeholders. The IENW and MiJV representatives both reflected on how the current regulations for professionals might still be too strict.
However, the shift of the responsibility for regulation to Europe halted further iterations on the Dutch regulations on recreational use. To still pursue the aim of addressing safety issues with uncertified users, regulators focused on efforts intended to improve the airmanship in this demographic.

5.2.3 Conclusions on the regulatory response to safety issues

Ultimately, public safety was ensured with professional ruleset and this ruleset enabled the economic development of the sector to begin. For ensuring public safety and allowing the sector to commence operations the professional ruleset received much support from the interviewees. For regulators involved in this process, the fact that accidents *did* occur was not even the main problem, as the regulations and proximity restrictions ensured safety.[450] As discussed in the results section, most safety issues were caused by uncertified recreational users of COTS-UASs.

The representatives of the COTS-UAS sector recognized the challenges that regulators were confronted with. However, despite their objections to the recreational ruleset the UASs sector are generally satisfied with how professional use was made possible and updated to correct the initial bias against professional users. A main objection of the sector was that recreational users had higher weight limits and more lenient proximity restrictions than ROC-Light professionals. Especially, considering that oversight and enforcement was problematic and that uncertified users were the main cause of safety issues.

However, there is a need to separate manned and unmanned aviation ways of thinking. Furthermore, there is a need to adapt regulatory processes, both in the government and the military, concerning emergent technologies. To counter response gaps between regulation and emergent technologies countries will have to invest into adequate numbers of people, with relevant knowledge, in order to ensure that regulators can task the necessary numbers of people to specific subjects.

In turn, there was indirect support for Marchant and Wallach's concept of a GCC. However, the Dutch government's response already involved engaging with industry stakeholders to identify mutually beneficial solutions, reflecting the approach suggested by Marchant and Wallach.

In addition, the infrastructural density of the Netherlands, combined with large amounts of restricted airspace and CTRs also prevented quick regulatory responses. The desire to keep manned aviation safe led to the decision to ban COTS-UASs from CTRS. However, this decision was influenced predominately by COTS-UASs safety features having to mature because regulators respect the expertise and capabilities of ROC holders.

[450] Mommers, *Masterwork Transcription Document*, 131.

5.3 Assessing the Dutch response to security issues

A clear need for countermeasures to drones was identified in 2015, which led the MiJS, alongside its partners, to pursue these.[451] As a result, these institutions began to research, develop, and test means of "detection, identification, and neutralization" in 2015.[452] However, response gaps related to security occurred due to the R&A of COTS-UASs initially outpacing the development of countermeasures and detection systems.[453]

5.3.1 Transparency, Immunization, and safety and security

Both the NOASR's findings and the interviews confirm that the R&A of technological developments led to regulatory response gaps. With regard to regulations on security issues, an interviewee stated that "If we change the rules and regulations due to terrorists, then the terrorists have already won".[454] As stated in the field of CTS, the civil liberties of citizens should not be infringed, nor should legislation or regulations be rashly implemented out of fear. However, this does not mean that regulations cannot support security. Regulations that enable higher the levels of transparency and immunization in terms of public safety also increase the deterrence of security threats. Therefore, regulations should focus on enabling transparency and attribution of drones to their operators, as opposed to directly responding to terrorism. However, problems with transparency, enforcement, and catching and punishing transgressors made oversight and enforcement an issue in the Netherlands. Finally, significant security-by-design features could not be mandated by Dutch regulations due to the regulatory shift to Europe and the small size of the Dutch COTS-UAS market.

Security issues were initially addressed by increasing research and development efforts into COTS-UAS countermeasures. Initial responses focused to security issues focused on developing passive and active countermeasures to COTS-UAS. This focus on developing countermeasures was a form of Homeland Security. Eventually, the MiJS efforts resulted in multiple means of detection: specifically an acoustic option, a radar option, cyberwarfare measures, and an option the research is not allowed to discuss. With regard to countermeasures, there have been significant efforts towards identifying and developing effective options for the Netherlands. Dutch regulators have developed these options by cooperating with the UAS industry, as well as with knowledge/technical institutes with close relationships to the government.

First, the development of countermeasures was hindered because different types of UAS require different kinds of jamming depending on their guidance systems. Second, in terms of ensuring security, there is a distinct need to control where hostile UAS crash or land because, if a hostile craft is carrying a payload, it should not be allowed to simply crash anywhere. The case of counter-drones, referring to UASs designed to intercept or neutralize hostile UASs, represents an arms race issue. Therefore, despite the fact that they play a niche role in intercepting UASs for safe disposal, relying excessively on counter-drones will only accelerate the development of both hostile UASs and counter-drones.

Over the course of this research, media coverage of the threat posed by the development of COTS-UAS technology was mentioned frequently. However, from the interviews, a different picture

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[451] Tweede Kamer der Staten Generaal, *Kamerstuk 30806 NR. 28*, 14.
[452] Ibid., 14 (my translation).
[453] Mommers, *Masterwork Transcription Document*, 33.
[454] Ibid., 138.

emerged concerning the usefulness of the technological development of UASs, as it was found that the improvement of UAS technology is more of an opportunity to improve S&S. Meaning, COTS-UASs' technological development is a greater benefit to countering many of the risks and threats that media tends to depict. Finally, interviewees discussed the role that framing COTS-UASs as tools for terrorism has had on the Dutch UAS sector. From CTS theory we know that such framing can negatively affects security by providing publicity to terrorist acts with COTS-UASs and skewing public opinion of COTS-UASs negatively.

5.3.2 Concluding the assessment of the security response

Dutch detection systems offer the following advantages: The larger COTS-UASs become, the more detectable they become for Dutch acoustic and radar detection systems. Because, the larger a payload, the larger the UAS needed to carry it. Larger UASs are significantly more detectable due to their size and the noise that they make. Small UASs can only carry relatively small payloads in comparison to other means of delivery. Furthermore, based on the findings of this research, the Netherlands is equipped to respond to a terrorist attack involving COTS-UASs. This occurred through efforts increasing the amount of available options to the Dutch state to counter security issues. The electronic and cyberwarfare options available to the Netherlands can deal with both individual and multiple COTS-UASs The development of the mentioned detection systems and active countermeasures reflect Homeland Security efforts. These efforts are in line with the requirement to first develope responses to the most potentially damaging threats, as was mentioned by the Remote Control Project, but no such attack has taken place in the Netherlands. Furthermore, these HS efforts are sensitive to the displacement effect which led interviewees to support investing in I&P to counter terrorism overall, not just terrorist use of COTS-UASs.

Because there has not been a confirmed intentional security threat involving a COTS-UAS in the Netherlands it is difficult for regulators to justify further investments in developing detection measures.[455] Particularly given the detection systems that the Netherlands has at its disposal and is still developing.[456] Furthermore, detecting trespassing UASs has proven to be an effective deterrent on its own.[457] Developing additional regulatory and passive countermeasures helps to address the short response times that are currently the case when unidentified UASs are detected.[458] When Dutch institutions conducted tests, they concluded that, even with the best equipment currently available, one only has seconds, as opposed to minutes, to respond to unidentified UASs.[459] However, passive countermeasures such as jamming are not harmless simply because they are not kinetic. Jamming is forbidden in the Netherlands; only the police are allowed to jam communication frequencies as it can prove damaging to the rest of the nation's communication infrastructure.[460]

Adequate means of detecting hostile COTS-UAS are available to the Netherlands. While the research is not permitted to mention all of these options and their effectiveness, a gap in detecting UASs for security purposes was not identified in this research. What can be stated is that Dutch institutions

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[455] Ibid., 33-34.
[456] Ibid., 32, 124.
[457] Ibid., 25.
[458] Ibid., 28.
[459] Ibid., 15
[460] Ibid., 140.

have co-developed acoustic and radar detection measures, due to the need for cheaper alternatives to military systems, specifically for COTS-UASs. The Dutch response in terms of developing means of detection is ongoing, and there have been some promising developments with regard to combating unwanted use of UASs. Due to the agreements made with the interviewees, the research does not further comment on these countermeasures or detection systems.

Chapter 6: Conclusions

The data from both the white papers and the interviews explains why certain updates were made (or not made) to the Dutch regulations between 2015 and 2018. It is worth noting that the interviews supplied data that was not available in the white papers. Such data concerned topics such as security issues, UAS countermeasures and the framing of terrorism involving COTS-UASs. However, the interviews also contributed unique information on the Dutch regulatory response not available in the white papers.

6.1 Addressing the hypotheses to the main research questions

Main hypothesis 1: A response gap between Dutch regulations and COTS-UAS occurred due to the *rate and acceleration* at which said technology evolved.

In the Netherlands, the R&A of the technological development of COTS-UASs, combined with that of other technologies, was the main cause of an initial response gap. This is confirmed by both the white papers and the interviews. However, over the years, the following factors also contributed to gaps between the regulatory response and public safety issues.

Alternate hypothesis 2: A response gap occurred due to obstacles within the regulatory process, such as the organizational structure of the ministries.

As indicated by the results, it was difficult to make rapid regulatory changes due to the need for such changes to be reviewed by other ministries. Furthermore, updating regulation was costly and inefficient because manned-aviation legal frameworks had been applied to UAS. If regulations on COTS-UASs had been made from a separate, unmanned-aviation perspective regulatory responses would have benefitted.

Alternate hypothesis 3: A response gap occurred to resource constraints: time, people, finances, and/or materials.

The low number of people tasked to the COTS-UAS subject negatively influenced the regulatory response process. The issue was *how many* people were assigned to the subject, rather than how many people were available within the government. First, the interviewees specifically stated that the number of people tasked on regulating drones proved to be a primary constraint. In addition, the interviews indicated that this shortage of people continued during both the early and later years of the regulatory response process. However, interviewees were positive about the expertise and effort of current regulators.

Due to the interim between European and national-level regulations, the time required for and the resource costs of updates, correcting the recreational ruleset remained one of the largest response gaps. In this way, the RRSE led to time and resource constraints in closing the gap that existed between the recreational ruleset and COTS-UAS reality.

Rival hypothesis 4: Safety and security issues were not identified in time, which prevented a proportionate regulatory response.

Due to the RDC and NOASR's research, regulators were well-aware of safety *and* security issues associated with COTS-UASs in 2015. As S&S issues were identified relatively early in the regulatory process rival hypothesis #4 is refuted.

Rival hypothesis #5: There were/are no longer any response gaps between the regulatory response of the Netherlands to the emergent technology of COTS-UASs and the development of such drones

This rival hypothesis is clearly refuted based on the response gaps with safety and security that occurred due to R&A. Furthermore, subsequent gaps arose due to the SRRE, the limited number of people tasked with addressing the issues associated with UASs and the application of manned aviation thinking to unmanned aviation.

A initial disparity between COTS-UASs and available countermeasures occurred because the R&A of increased affordability, capabilities, and proliferation of COTS-UAS proceeded faster than responses could be developed. However, a remaining gap in terms of security was not found during this research. This leads to the conclusion that, for now, the aforementioned security gap has been closed by the co-development of Dutch passive and active countermeasures that enable detecting, attributing, and combatting COTS-UASs security threats.

6.2 Answering the main research questions

Main research question:

1. *Is there a response gap between the technological development of COTS-UAS and the regulatory response of the Netherlands in terms of safety and security issues?*

Several response gaps occurred between Dutch regulations and COTS-UASs within the time frame of 2015 to 2018. These gaps were addressed by various means and to various degrees by Dutch regulators and by Dutch actors and stakeholders linked to UASs.

The following gaps can be considered to have been closed over time based on the results of this research:

The gaps between the reality of COTS-UASs and the professional rulesets.

The gap related to countermeasures against COTS-UASs security threats.

The following gap is considered to have remained open due to cosmopolitan challenges stemming from the SRRE and corresponding time and resource constraints.

The gap between the reality of COTS-UASs and the Dutch recreational ruleset.

2. *If there is a gap in terms of safety and security issues, how can this gap be explained?*

To answer MRQ 2, gaps, in terms of safety, arose because dated (manned aviation) perspectives were applied to new COTS-UASs technology. Second, the rate and acceleration of COTS-UASs developments quickly led to the regulations no longer matching the reality of how COTS-UASs were used in the Netherlands.

This led to Dutch regulators updating their regulations to increase the connectedness between the reality of COTS-UASs and the professional rulesets. However, the regulatory response process to COTS-UASs was complicated throughout the years due to the few people tasked to regulate COTS-UAS.

Finally, the gap with the recreational ruleset remained due to the interval between the implementation of national- and European-level regulation on aircraft under 150 kg. Attempts to address the discrepancies between the recreational ruleset and the professional rulesets were hindered, and eventually stopped, due to the impending European regulations. Finally, the size of the Dutch market, in combination with the desire for European-wide regulations, meant that neither by-design features nor nation-wide means of promoting transparency were implemented.

6.3 Conclusions on safety issues

The interviews indicated that the high-level meetings held with actors and stakeholders had a positive effect on the regulatory response. Therefore, the Dutch response signifies the benefits of increasing coordination and communication between regulators, actors, and stakeholders. However, regulators' ability to quickly roll-out responses was also complicated because drafted responses had to pass the review of multiple government stakeholders. The interviewees had clear points of criticism, but were overall pleased with the updates to the regulations for professional use. The professional ruleset ensures high levels of airmanship through certification and the HETI performs technical examinations of COTS-UASs used by professionals.

The fact that professional use was more restricted in 2015 had more to do with the lack of technical quality of early COTS-UASs and a lack of data upon which to base decisions than a lack of expertise and competence on the part of professional UAS pilots. To conclude, the incorrect assumption that professional users would be responsible for the most safety issues led to an early gap between professional regulations and reality.

In addition, professional regulations were updated over time to better reflect the reality of COTS-UASs and make professional use more possible. These updates corrected much of the interviewees' objections to the 2015 professional ruleset. For instance, over time, professional users were allowed to fly higher, further, and closer to people or infrastructure. However, the fact that the recreational ruleset was not updated further displeased the professional sector. The case of the recreational ruleset was, and remains, one of the larger response gaps in the Dutch case.

For public safety, levels of oversight and enforcement of the regulations are low due to difficulties in detecting and attributing drones and subsequently identifying transgressions involving COTS-UASs. Oversight and enforcement problems with uncertified or illegal COTS-UASs remain due to the identified problems with the availability of detection equipment, the attribution problem, and the need for a European-wide UTMs.

What can correct the aforementioned public safety issues is physical and non-physical infrastructure, such as that which is present for manned aviation and other forms of traffic, that can support UAS operations but also enable oversight and enforcement. However, due to the identified cosmopolitan challenges stemming from the SRRE implementing such measures specifically for the Netherlands is inefficient. Which is why regulators sought to increase immunization against public safety issues through proximity restrictions in the professional ruleset and to increase airmanship with recreational users through public awareness campaigns on COTS-UASs.

6.4 Security conclusions

In the early years of the researched timeframe, COTS-UASs developed and proliferated faster than available countermeasures evolved. Over time, adequate means of detection were developed, as well as electronic and cyberwarfare countermeasures against security threats. No contemporary response gap in terms of security issues associated with UASs was identified during the course of this research. In particular, due to the means of detection and combatting of hostile drones mentioned by interviewees.

The topic of countermeasures is complicated. First, when one has a potential UAS threat, it is important to control where that threat will land or crash. A payload might not reach its intended target, but it could still do harm wherever it does land/crash. Security can be complemented by counter-drones that intercept hostile UAS. However, excessive reliance on counter-drones may result in an arms race. Finally, active and passive countermeasures will remain a compliment to regulatory countermeasures due to self-built and black market UASs.

Thus, combining detection of all UASs alongside a system that identifies law-abiding UASs would allow one to detect non-cooperative UASs and assist in determining which UASs are "good" and which are potentially "bad" or risk-prone. Such a system would in turn provide regulators with a clearer impression of the reality of COTS-UASs operations and allow for effective use of detection, attribution, and counter measures against either safety or security threats.

COTS-UAS countermeasures are available, but they remain costly. Furthermore, they are not developing at the same rate as COTS-UASs. Currently, no single system is able to deal with the entire spectrum of monitoring, detecting, discriminating, and combatting and the various types of UAS guidance systems. Geofencing is important, but it is currently not robust enough to serve as a viable security measure. Geofencing is effective on most fly out of the box users but also hinders Dutch police operations. Furthermore, geofencing can be easily removed without requiring much effort. Furthermore, geofencing systems that exist are still brand-specific and therefore not universally in place for all COTS-UASs.

Finally, there is a bias towards viewing COTS-UASs predominately as a means of delivering hostile payloads. There is a trend in terms of discussing drones as tools for terrorism, even though other means of delivering hostile payloads would be preferable and more effective options than the use of COTS-UASs. Such a negative framing can increase the likelihood that COTS-UASs may be used either to cause panic or because using COTS-UAS results in media attention. Finally, terrorists mostly use COTS-UAS for their intelligence and surveillance purposes and it is in this way that COTS-UASs offer a new contribution to terrorists' capabilities. Finally, there are more opportunities to increase security by working with, instead of against, the technological development of COT-UASs. For example through regulations that promote transparency and immunization through mandating safety- and security-by-design features on an EU-wide level. In terms of COTS-UASs being used as tools in conflicts abroad, the greatest gains lie in denying terrorists the ability to use COTS-UASs at all by methods of deterrence by denial.

With regard to domestic security, investing in I&P efforts will enable the detection and apprehension of terrorists regardless of whether they choose to use COTS-UASs or not. Dutch Homeland Security efforts, such as the development of their acoustic, radar, and electronic passive and active countermeasures can be used to protect key locations from disruption but remain sensitive to the displacement effect. However, there has been no confirmed case of a hostile COTS-UAS in the Netherlands. Therefore, to not simply focus on the threat of COTS-UAS, but terrorism in general, investing in Intelligence and Policing efforts will be greatly beneficial to domestic security whilst Conciliation and Dialogue remains important to decreasing terrorism globally.

6.5.1 Recommendations for future praxis

Future researchers are advised to inform themselves on the technicalities of UAS, as this allows for more meaningful conversations with interviewed experts. Discussing the subject of terrorism with UASs actors and stakeholders is a sensitive issue due to the negative framing the sector has experienced as discussed in this research. Therefore, if future researchers wish to pursue similar subject matter they are recommended to be critical of their own position, potential (academic) biases. Approaching the sector with a research objective that does not contribute to a negative frame is likely to improve the number of people willing to participate in your research. Finally, it has been clearly stated throughout this research that the positive gains for society lie in working with, instead of against emergent technologies. The benefits of increasing coordination and communication between regulators, actors, and stakeholders have been confirmed in the Netherlands. Finally, as identified by Brownsword cosmopolitan challenges in regulating technology beyond the national level have led to difficulties for national regulations to stay connected to COTS-UASs developments. Therefore regulation of future technologies should focus on quickly increasing coordination and communication to introduce adequate regulation without resulting in interims which can potentially cause national-level discrepancies.

6.5.2 Future research suggestions

In terms of the security issues associated with COTS-UASs and the technological development of COTS-UASs: future challenges include advancements in imagery recognition software, artificial intelligence, and swarming. Furthermore, the low cost of current COTS-UASs ensures that criminals will not be deterred by the risk of losing their UASs. However, Dutch ministries have already been tasked with dealing with such future challenges. Therefore, for future research, looking into what sort of S&S by design features are actually effective is recommended. Finally, instead of researching the use of COTS-UASs by terrorists to deliver payloads, looking into their use for surveillance and intelligence is by either terrorists or criminals is recommended. Future research can look into how COTS-UASs can be barred from entering conflict zones and must be careful to not contribute to a negative framing of UASs.

6.6 Reflection

First, the scope and complexity of the researching both the topic of COTS-UASs in combination with the related regulatory responses, in terms of both safety and security, proved tremendous. Second, the amount of collected data, and the time it took to transcribe and analyze it all, was enormous. Luckily, there was a lot of consensus between the interviewees which allowed this information to be distilled into a clear assessment of the Dutch regulatory response. Therefore, despite the hardships, this endeavor has resulted in a meaningful, and interesting, contribution to the understanding of contemporary topics such as COTS-UASs regulation whilst providing additional data for the debate on COTS-UASs safety and security issues. The research could have benefited from including more parties involved in the Dutch response to COTS-UAS. However, many of these individuals and organizations were approached but unfortunately proved unresponsive.

The utilized theories all proved highly useful in understanding and working with the subject matter. Possible generalizations from this research can be what worked, and what hindered, increasing the connectedness and effectiveness of the Dutch regulatory response to an emergent technology. Therefore, this research can be of use to future regulators faced with emergent technology governance challenges. Knowledge of the Dutch case provides a better understanding of what can, or should, be done in the face of new technology. Furthermore, the results of this research support the argument for deterrence by denial and intelligence and policing to ensure domestic security.

Conducting this research was a long process full of hard work in which difficult decisions had to be made. Here at the end the researcher is confident in that a truthful and accurate picture has been painted based on the collected data. However, none of this would have been possible without the help of those individuals, and organizations, whose contributed to the realization of this research.

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Appendices.

Appendix A (Research Information Document)

Note, due to the iterative approach, certain phrases and words differ from those that were finally used in the finalized thesis. However, this is the RID as presented to participants in Q4 of 2018, including how the in-text references were formatted. However, the references in the RID are not part of the main thesis.

Research Information Document

The interview can be done in English or Dutch. At the end of this document a Dutch translation of the guiding questions is included. The nature of the semi-structured interview allows for a conversation which ensures room for the expertise of the participant.

Working Title:

Emergent Technology and Regulatory Response: An explanatory Case Study of Remotely Piloted Aircraft in The Netherlands.

Note on Terminology:

Although a colloquial term, drone is used to include both RPAs and sUAS. Currently, there are many definitions that apply to different forms of a technological family. For brevity and inclusiveness the term *drone* will be used.

Type of research:

An single case study executed by qualitative methods. The case study focusses on the regulatory response in the Netherlands to emergent RPA/UAS (or "drone") technology. Sources of data are secondary literature, policy and legal documents, and interviewees with expert knowledge. Knowledge gained by these interviews has the option to influence the research process; allowing for an iterative approach.

The Netherlands is the Research Unit whilst the interviewees (experts on relevant subject matter) are the research's data sources. In short, the "purpose is to explain how or why some condition came to be (e.g., how or why some sequence of events occurred or did not occur)."[461]

The research focusses on challenges to the successful integration of the emergent technology into Dutch society. It does this by investigating the development of relevant regulation and by focusing on safety and security issues. This is due to such issues being relevant to many other aspects of both the technology and Dutch society. For example, for successful economic integration addressing safety and security issues can influence the public's acceptance of that technology in their environment. An upcoming technology may pose great economic and logistical potential but can also be hindered by safety and security issues. Finally, if safety and security measures are taken then how do these affect the technology and stakeholders in the industry?

[461] Yin, Case Study Research Design and Methods, 2014, 238.

This allows for multiple viewpoints to be included within this research. It is of importance to allow the interviewed experts to express *their* vision on the development of the Dutch regulatory response to commercial RPA/sUAS technology. The iterative approach ensures new findings can be included to steer the inquiry to a truthful representation of the actual situation. Finally, it is important to consult many different experts, on both the technology and regulations, to protect against one-sided representations.

Regulation in case of this research:

Regulations are, "the way the legislation is enforced by regulators and they support the requirements of the legislation."[462] Differing from legislation, regulations are a requirement supported by legislation on a higher level.[463] Legislation is introduced by a head of state and regulations are enforced "by regulators", such as the Dutch Ministries, without interaction with the head of state.[464] Finally, " Legislation is almost always internally generated within a country's government while regulations may be internally or externally generated, especially pertaining to certain industry."[465] To conclude, regulations are how legislation is enacted by those responsible for its enforcement.[466]

Research Objective:

To explain the development of the Dutch regulatory response to the challenges posed by emergent commercial-off-the-shelf drone technology, specifically those to safety and security.

Main Research Question:

> Is there a response gap between the technological development of commercial-off-the-shelf drones, and the regulatory response of The Netherlands, and if so, how can this gap be explained?

Sub Question(s):

From a safety perspective:

> How does the development of COTS-drone technology complicate, or challenge, the Dutch regulatory response?
>
> How do the current regulatory measures for COTS-drones deal with safety issues in order to integrate the technology in Dutch Society?
>
> What factors influence Dutch regulators in their decisions concerning COTS-drone technology?
>
> What regulatory measures do, or could, aid in the public acceptance of drone technology to ensure benefit from COTS-drone technology?

From a security perspective:

> How can regulations aid in protecting against hostile acts with commercial-off-the-shelf drones?

---

[462] Kivumbi.
[463] Kivumbi.
[464] Kivumbi.
[465] Kivumbi.
[466] Kivumbi.

How does the development of COTS-drone technology increase the capacity of potential terrorists?*

Bias: Is there a bias from either actors or researchers, towards viewing COTS-drone technology from a perspective that focusses on terrorism and, if so, how does this influence the regulatory response?

How can The Netherlands use or regulate COTS-drone technology to ensure its own security.

The Deterrence equation:

In an article published in Strategic Studies Quarterly the retired Colonels John P. Geis II and Theodore C. Hailes discuss how deterrence theory applies to existing threats as well newer threats as a result of emerging technologies.[467] This research sees their solutions of increasing transparency and immunization in order to deter threats as potentially beneficial to formulating responses to emergent technology. From this perspective deterrence theory is not only the protection against hostile acts but can also positively influence technology integration.

Although Geis and Hailes focus on biotechnology, nanotechnology, and direct energy their views can also be applied to emerging COTS-drone technology. Although they focus on the United States their perspective can also be of use to The Netherlands. By achieving a better understanding of a regulatory response to emergent technology valuable information can be obtained. Knowledge, not only about deterrence theory in relation to emergent RPA/(s)UAS technology, but also about the process of formulating a regulatory response to this technology in general.

Transparency and Immunization.

For Geis and Hailes, transparency allows for the timely identifying of those individuals who use a particular technology. Increasing transparency could also aid in fostering public acceptance of drone technology alongside protecting against harmful side-effects or misuse. If hostile actors believe their actions are highly discoverable and attributed to them these actions will likely be deterred.[468]

Systems that foster transparency might also ensure smoother integration of the technology's beneficial effects into Dutch society. Next to safety advantages increasing transparency might also be an economic gain to the Netherlands. To allow for transparency, the attribution problem has to solved. The attribution problem consists of connecting the actual person to the technology being used. With COTS-drones this mean identifying who owns or controls the aircraft. Immunization is the process of ensuring that possible attacks are reduced in their effectiveness. Or, if an attack succeeds, or accident occurs, there will be no significant damage (resilience). Increasing deterrence by immunization tilts the equation back in favor of the defender because the value, or impact, of an attack or event will be minimalized. These concepts are of use in assessing which types of responses to potential safety and security risk are deemed best by the respondents to this research.

[467] Geis and Hailes, 2016, 47.

[468] Geis and Hailes, 65.

Appendix B

The Consent form and Questions for the Semi-Structured Interviews:
In English and Dutch. All nine filled-in consent forms are in possession of the researcher.

Consent form

Researcher:

Researcher's function:

Address and contact information:

Date:

With "I" is meant the participant to this study (otherwise known as the interviewee)

1. **I understand the nature of the research after having been provided with relevant information and the opportunity to ask questions.**

   Yes **No**

2. **I voluntarily participate in this research and have been informed that I may pause, or stop, the interview at any time. I am not obligated to give the researcher an explanation if I decide to pause or stop with the interview. I may also choose to answer questions off-the-record: audio recording will then be stopped for the duration of this situation.**

   Yes **No**

3. **I acknowledge that, if I have chosen to have my identity remain confidential, this can only be done to the extent permitted by the law.**

   Yes **No**

4. **I give written permission for the audio and/or video recording of this interview**

   Yes **No**

5. **I give permission to the researcher to use the gathered material in their research and also give permission for the printing of my quoted material in the final version of the research.**

   Yes **No**

Participant/interviewee **Signature participant/interviewee:**

Researcher: **Signature researcher:**

Case Study Protocol Section C (Data Collection Questions)

Introduction:

1.0

For the documentation and analysis of this research I will be recording this interview through the recorder, or the app on my smartphone. When I start the recording would you kindly state your name and state that you have given permission for the recording of this interview?

/

Voor het kunnen analyseren en documenteren van dit interview zal ik deze opnemen via de recorder en/of via de app op mijn smartphone. Wanneer de opname begint vraag ik u duidelijk uw naam te zeggen en te verklaren dat u toestemming geeft voor deze opname.

>Let the participant read the consent form which is to be signed, if the participant still wishes to do so, at the end of the interview.

> Start recording.

> Ensure that the Philips Voice Tracer's red light is burning.

> Let the participant state their name and their permission for the recording of this interview.

1.1

First of all, thank you for choosing to take part in this interview.

/

Allereerst wil ik u bedanken voor het deelnemen aan dit interview.

1.2

About the research:

This research's objective is to gain explanatory knowledge concerning the development of the Dutch regulatory response to the emergent technology of commercial-off-the-shelf drones. In particular, in relation to safety and security issues.

/

Over het onderzoek:

Het doel van dit onderzoek is het verklaren van de ontwikkeling tussen de handhavingsreactie van de Nederlandse overheid en opkomende commerciële drone technologie. Vooral wat betreft veiligheidskwesties.

1.3

I want to inform you that as a participant in this research you have the option of anonymity. This means that you will only be addressed by your workplace, function, or by any other way you prefer within the research.

What is your preference?

/

Als participant aan dit onderzoek kunt u kiezen dat uw naam vertrouwelijk blijft en dat u alleen genoemd zal worden in dit onderzoek per instantie of per de functie die u betrekt. U mag ook zelf een benoeming specificeren. Wat is uw voorkeur?

1.4

If you wish to pause, or end, the interview you may do so at any time during the interview.

/

Wenst u het interview te pauzeren of te beëindigen dan mag u dit op ieder moment aangeven.

The questions for the main semi-structured interview.

(Questions do not have to proceed in order but are numbered for future reference. The questions are meant to introduce and check-off certain topics. The main focus is on including the unique knowledge of the expert on the primary subject.)

/

(De vragen voor het interview moeten niet op volgorde maar hebben nummers voor de latere analyse. De vragen verzorgen het introduceren en aan bod komen van verschillende onderwerpen. Het hoofddoel is het betrekken van de unieke kennis van de expert over het hoofdonderwerp.)

General background

2.0 What is your profession and what are your responsibilities within this profession?

/

Wat is uw beroep/functie en wat zijn uw verantwoordelijkheden binnen deze functie?

2.1 What has been your professional experience in relation to commercial off-the-shelf, or military, drone technology?

/

Wat is uw professionele ervaring met commerciële, of militaire, drone technologie?

Regulation and Emergent Technology

2.1 How do you think regulation can aid in fostering positive effects or preventing negative effects from the development of this technology? Or is this situation beyond the responsibility of regulators?

/

Hoe denkt u dat regelgeving en handhaving mogelijke positieve effecten kan ondersteunen en nadelige effecten kan voorkomen met betrekking tot commerciële drone technologie? Of ligt dit buiten de verantwoordelijkheid van de betreffende partijen?

2.2 In your opinion, how does the technological development of COTS-drones pose problems for entities in the Netherlands wanting to regulate that technology?

Expanding question: how does the development of other technologies complicate this issue? (Ask about compound effects, possible examples: increased carrying capacity, sense-and-avoid technology, GPS, nanotechnology, swarming, fly-per-view, greater bandwidth, proliferation)

/

Naar uw mening, hoe bemoeilijkt de technologische ontwikkeling van commerciële drone technologie het werk van de regelgevende agentschappen en organen in Nederland? Hoe denkt u dat de ontwikkeling van andere technologieën de situatie kan beïnvloeden?

2.3 What challenges does COTS-drone technology pose to the job of regulators wanting to ensure safety and security?

/

Welke uitdagingen presenteert commerciële drone technologie op het gebied van veiligheidskwesties aan de instanties verantwoordelijk voor regelgeving en handhaving?

Deterrence: Transparency and Immunization.

2.4 How does the technology's development affect the ability of regulators to identify those that use the technology. (the problem of attributing the act to an actual person)[469]

/

Hoe beïnvloedt de technologische ontwikkeling het vermogen van de verantwoordelijke partijen om de directe gebruikers van commerciële drone technologie te identificeren?

2.5 In your opinion, does the development of the technology's potential for terrorism pose problems? If so, how?

Expanding question: In your opinion, does the technology increase the capacity of terrorists. If so, how?

/

Naar uw mening, levert de ontwikkeling van deze technologie problemen op gezien een potentieel voor terrorisme[470]? Indien het geval, hoe? (In de voetnoot de definitie van terrorisme van de Nederlandse Coördinator Terrorismebestrijding en Veiligheid)

Toevoegende vraag: Naar uw mening, vergroot de technologie de capaciteiten van terroristen. Indien ja, hoe?

---

[469] Geis and Hailes, 59.

[470] Volgens de definitie van de NCTV:

" Terrorisme is het uit ideologische motieven dreigen met, voorbereiden of plegen van op mensen gericht ernstig geweld, dan wel daden gericht op het aanrichten van maatschappijontwrichtende zaakschade, met als doel maatschappelijke veranderingen te bewerkstelligen, de bevolking ernstige vrees aan te jagen of politieke besluitvorming te beïnvloeden.

2.6 What challenges do regulators face in protecting against accidents as well as hostile acts with COTS-drones (Expand on the problem of immunization "immunization is a protective measure that reduces attack effectiveness" and that immunization can also be the ability to deal with accidents)[471]

/

Welke uitdagingen hebben de regelgevende agentschappen en organen wat betreft het waarborgen van de veiligheid met betrekking to drone technologie? Zowel in het geval van ongelukken als in het geval van opzettelijke daden.

Countermeasures.

2.7 How do you think the development of available, or appropriate, countermeasures to the harmful use of COTS-drones is proceeding in The Netherlands?

/

Naar uw mening, hoe verloopt de ontwikkeling van beschikbare, of geschikte, maatregelen tegen het vijandige gebruik van commerciële drone technologie in Nederland?

2.8 What are challenges, specifically for The Netherlands, to the development of adequate countermeasures against COTS-drones?

/

Wat zijn specifieke uitdagingen voor Nederland op het gebied van tegenmaatregelen tegen commerciële drones te ontwikkelen?

Final Inquiry:

3.0 Do you have any further comments, remarks, or ideas you would like to add to this interview?

/

Heeft u nog verdere opmerkingen of ideeën die u graag aan dit interview zou toevoegen?

3.1 How would you describe your experience with this interview?

/

[471] Geis and Hailes, 66. Further: Similarly, a nation-state properly immunized against attack will not suffer significant damage, even if an attack is launched against it.

Hoe omschrijft u uw beleving van dit interview?

3.2 Did you find anything missing in my line of inquiry or is there a subject, or aspect, you felt was left underappreciated?

/

Naar uw mening, mist er iets in mijn vraagstelling of is er een onderwerp of aspect waarvan u vindt dat dat deze te weinig aandacht krijgt?

3.3 Would you advise any other individuals or organizations for me to interview on this topic? If so, could you facilitate contact?

/

Zijn er andere individuen of organisaties waarvan u vindt dat zij ook betrokken moeten worden bij dit onderzoek. Indien het geval, kunt u dan assisteren bij het contact leggen met deze personen of instanties?

3.4 Would like to receive the transcription of this interview and the opportunity to correct or amend anything before it is used in this research?

/

Wenst u de transcriptie van dit interview te ontvangen teneinde deze te kunnen corrigeren of becommentariëren voordat het in gebruik treed van dit onderzoek?

Ending the interview:

4.0 Thank the interviewee and ensure that you have transferred your contact details.

/

Bedank de participant en controleer of je contactgegevens overgedragen zijn.

4.1 Ensure the recording device has stopped recording. Permission for recording does not extend past the interview.

/

Stel zeker dat de opname apparatuur geen audio opname meer maakt. Toestemming voor het maken van audio opnames is niet verstrekt voor na het interview.