The Dual-use of Drones*

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Drones and drone-related technologies were initially developed for military purposes. Their adaptability as universal platforms for sensing and payload transportation has driven their increasing proliferation in the civilian domain. This paper investigates the ethical aspects of dual-use of drones and drone-related technologies. These aspects encompass issues generated by the transfer of drones and drone-related technologies from the military domain into the civil domain, and issues stemming from the inherent nature of drones and drone-related technologies. Key themes, such as safety, security, and privacy will be explored, along with existing and potential solutions proposed for addressing ethical issues related to the dual-use of drones and drone-related technologies within the civil domain. This paper forms part of the Netherlands Organisation for Scientific Research (NWO) project 'Responsible Design of Drones and Drone Services: Towards an Ethical and Juridical Tool For Drone Design and Risk Assessment' (Project no. 313-99-318), which aims to develop a tool for use in Responsible Research & Innovation (RRI) for the Value Sensitive Design and implementation of drones and drone technologies. Understanding the ethical challenges and proposed solutions regarding dual-use should better inform the RRI, VSD and implementation of drones and drone technologies.

1 Introduction

In 2016, after more than 2 years of planning, the construction of a 1900 km long oil pipeline began, known as the Dakota Access Pipeline. The pipeline was designed to cross four US states: Illinois, Iowa, South and North Dakota, connecting under the ground the Bakken shale oil fields in North Dakota with oil tank farms in Illinois. The rationale behind the building of the pipeline was safety, compared with road and rail transport to the rafineries. The local population (mostly native American tribe members and their supporters) repeatedly expressed their opposition and filed petitions, without result. Most of the pipeline was built, but the part in the vicinity of Standing Rock, near burial and sacred sites of the Sioux Tribe still awaited federal approval. Members of the tribe and their supporters set up camps where they protested against the construction company and their security personnel ('Dakota Pipeline: What's Behind the Controversy?', 2017).

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During the protests both parties, the protesting tribe members with supporters as well as private security companies and the police used drones for monitoring and surveillance activities above the protest site. Tribe members used drones to collect aerial footages of the protests at Standing Rock, gaining wider support from the public through social media coverage. On the other side, private security officials were gathering surveillance evidence, which were later used as evidence in court cases. The FAA, between October and November 2016, imposed a temporary flight restriction above the 400 km^2 land of the resistance groups, which ban has been renewed twice (Brown, Parrish & Speri, 2017).

Although the use of drones in military actions increased significantly after the 9/11 attacks, and is coined as a signature weapon of modern warfare, having been used actively in the War in Afghanistan and Iraq War, the Dakota Pipeline protests has a special significance. The Dakota Access Pipeline protests were the first well-documented case when drones were used to collect surveillance evidence against protesters, a minority group, in a non-military setting against a country's own population, by both public and private law enforcement agencies at the same time.

Emerging technologies often carry the risk of abuse by groups and individuals through negligence or malevolent intentions. Drone technologies, as a novel, emerging technology of the 21st century, are not an exception in this regard. Originating from both military development and civilian initiatives, drones are prone for to dual-use. The issue of dual-use is even more pressing due to the fact that at present, the technology is used by more than 90 nations world-wide (Finn & Wright, 2012; West & Bowman, 2016).

This article overviews a few of the dual-use possibilities of drones, with the motivation of highlighting the ethical nature of the dual-use dilemmas through some cases, and providing some practical recommendations for minimising them.

2 Ethics of Dual-use

The ethics of dual-use gained substantial importance after the development and application of military nuclear missiles at the end of World War II (Jogalekar, 2014). Leo Szilard, one of the conceivers of the idea of the nuclear chain reaction, drafted an essay about his imaginary trial as a war criminal, highlighting the questions about the ethical responsibility of scientists (Szilard, 1949). Although there is no agreed definition of dual-use, it's traditional definition is linked with research, technology, and artefacts that can be both applied to military and civilian contexts (Barazzetti, Diezi & Benaroyo, 2015). More recent definitions of dual-use describe it as occurring when a technology that is intended for application with primary good intentions (benevolent purpose) also has an secondary purpose that is negative (malevolent), which is unintended by its developers (Barazzetti, Diezi & Benaroyo, 2015, referring to Rath, Ischi & Perkins, 2014). Consequently, Barazzetti, Diezi & Benaroyo (2015, 6) define dual-use as follows:

Tijdschrift voor Veiligheid 2018 (17) 1-2
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> 'A research, technology, or artefact is dual-use if there is a concrete threat or a sufficiently high risk that it can be used to serve malevolent purposes (e.g. design or produce a weapon, endanger human health, compromise security, threaten fundamental human rights, etc.), where in neither case this is the intended or primary purpose.'

In science, dual-use dilemmas emerge when a particular research, technology, or artefact that has been created for good intentions can be potentially applied to cause harm. In detail, the dual-use dilemma in research represents the choice between causing intentional good on one hand, and predicting the possibility and consequences of providing means for causing harm on the other hand (Miller & Selgelid, 2008). Any ethical assessment does not include only the researchers themselves, but also extend to the oversight bodies. Moreover, an ethical assessment has to be conducted on a case-by-case basis, which is influenced by the value system surrounding the research, technology, and artefacts. Barazzetti, Diezi and Benaroyo (2015) define four general ethical principles that is applicable to dual-use dilemmas. These are (Barazzetti, Diezi & Benaroyo, 2015, 8-11):

- *Social responsibility of the researchers* – An emerging view in research ethics holds researchers socially responsible for the malevolent use of their well-intended research; while at the same time researchers have a duty to consider and foresee the actual and potential applications of their work.
- *'No means to harm' principle* – Incorporating the social responsibility principle, the 'no means to harm' principle considers potentially harmful research, technology, or artefacts as morally wrong, if a concrete threat or sufficiently high risk arises in relation to them; therefore, this principle relies on the judgement, assessment, and awareness of these risks of prospective harms.
- *Scientific freedom* – Being a key moral value, scientific freedom is grounded on the principle of freedom of intellectual enquiry as a fundamental human right. However, scientific freedom cannot be understood as an absolute freedom, as limitations to this principle may be justified by the overwhelming risks and harms that would outweigh the benefits of the dissemination of a particular knowledge.
- *Collective responsibility for dual-use* – The responsibility for the research, technology, or artefacts cannot be carried by the individual scientist alone, relying exclusively on one's self-governance. The responsibility is a collective effort on multiple levels, and it is a joint enterprise of universities, professional associations, governments, and funders.

A particular issue arises regarding collaborations on military research. According to Forge (2012, 2013), researchers should not engage in military research that has solely malevolent purposes (e.g. perfecting lethal weapons). Barazzetti, Diezi, and Benaroyo (2015) extends this criterion also to military research that has incidental friendly civilian applications, as the primary intended goal of such research is to develop lethal weapons with malevolent purposes. The ethical assessment of the dual-use principle in military research with the intention of designing solely defensive weapons is comparatively more complex regarding their expected bene-

fits and potential risks. An even more complex situation emerges regarding military-civilian joint research that develops technologies integrating both military and commercial applications at the same time. Such research collaborations have been promoted in the recent years.

The hybrid, military-commercial collaboration is especially prevalent in European countries, where the lack of accountability and oversight is hidden behind the veil of technocratic processes called roadmaps. These roadmaps are designed by EU officials, industry specialists and consultants, without the essential comments of the wider civil society, national parliaments, or the European Parliament (Csernatoni, 2016; Hayes, Jones & Töpfer, 2014). The lack of transparency and public accountability, as well as the objectives of such drone operations (e.g. surveillance, counter-terrorism, policing, border control) may be the source of further controversies. As a hallmark case of negative consequences stemming from lack of accountability and transparency can serve a recent controversy of Google employees, who were not informed about the purpose of the machine-learning software they were developing, which were used in military settings for analysing millions of hours of drone footage in order to identify future objects of interest. Media coverage reports at least dozen of Google employees left the company because of their disagreement with the non-transparent application of their software for such purposes (Amadeo, 2018). Although such an action is in accordance with the social responsibility and 'no means to harm' principle of dual-use regarding drones, it does not address on the systemic level the issues related with scientific freedom nor collective responsibility for dual-use on the level of companies, the military, or the state. In military-commercial collaborations, all responsible actors (i.e. not only individuals) should consider dual-use applications of the developed technology (Barazzetti, Diezi & Benaroyo, 2015). This consideration regarding military research, according to Barazzetti, Diezi, and Benaroyo (2015), should be also extended to members of civil society.

From this overview, it is evident that drones and drone-related technologies can be categorised into the dual-use definition that differentiates between the traditional military-civilian domains, as well as the definition that focuses on intentional beneficent and malevolent use. In the next sections, we shall highlight these dual-use issues in greater detail.

3 Characterisation of Drone Applications

Research conducted with drones extends to its operational use by governments, defense companies, and research institutions, while the Research & Development of drone-related systems is performed by universities and the public sector (Clarke, 2014a). The view that the application of drones is limited by one's imagination, due to its capabilities, is repeatedly noted in the literature (Finn & Wright, 2012; Pajares, 2015).

Currently, the most extensive application of drones occurs in military realms. However, non-military governmental, commercial, industrial, scientific, and other domains are following quickly. In the sections below, we focus our attention

Tijdschrift voor Veiligheid 2018 (17) 1-2
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on two particular domains: military and non-military governmental application of drones. This focus intends to highlight the context of substantial dual-use dilemmas. This description is then followed with the overview of the current legal and regulatory context linked with drone technologies and drone use.

3.1 Military Use

The military application of drones has received considerable attention in the media and in scholarly debate due to the capabilities of remote killing (also referred to as 'precision killing') and the public outcry this causes (Bendel, 2016). While, initially, drones have been used for covert observation, reconnaissance, and espionage (Braun, Friedewald & Valkenburg, 2015; Lidynia, Philipsen & Ziefle, 2017), the use has changed from surveillance to lethal missions against terrorists, first conducted in Pakistan around 2007 (Luppicini & So, 2016). Public concerns triggered ethical debate about the collateral damage caused by these actions (the ratio of civilian to terrorist casualties being 50:1 (Luppicini & So, 2016 referring to Lewis, 2014). There has also been a shift in the interpretation of military ethics and legality regarding the practice of killing with drones (Luppicini & So, 2016; Rao, Gopi & Maione, 2016). Moreover, the lack of transparency in the decision-making process regarding 'nonjudicial executions' of targets has also raised concerns (Culver, 2014; Rao, Gopi & Maione, 2016).

Besides the unintended consequences, what is at stake in these military actions is the possible impact on civil and non-military applications. With the distance between the operators and drones, the notion of 'military necessity to intervene' alters, as the meaning of the word 'battlefield' may be extended to any location on Earth (Culver, 2014). Similarly, any drone-like intervention may involve the highly problematic notion of 'collateral damage,' i.e. non-military damages and deaths, not intended but necessary, to achieve military goals (Wilson, 2014). Thus, drones may reinforce the culture of control and risk management currently present in non-military domains (Bracken-Roche, 2016, referring to Wall & Monahan, 2011).

For example, Israeli Defense Forces tested drones that drop tear gas on protesters in Gaza in 2018. Three types of drones were reportedly used, from which at least one has its origins in a commercial product. The use of these drones give the military forces new range, despite the fact that drones working on a similar principle (i.e. to deliver explosives) were used by terrorist groups earlier in other parts of the Middle East (Hilton, 2018; Schmitt, 2017).

It has been reported that commercial drones (available to the general public) are being used to observe or draw fire in the War in Donbass (2014–present; Hartmann & Giles, 2016). This would be the first documented case of drone-on-drone warfare (Hartmann & Giles, 2016). This fact confirms the ethical issue of possible dual-use of these technologies, namely, when war-like activities are conducted from great distance and remotely (Boucher, 2015).

3.2 Non-military Governmental Use

While military drones carry an acronym of M-RPAS, their repurposed variants for domestic use are often abbreviated as C-RPAS (Boucher, 2015). States recognise

the opportunity offered by drones in crime-fighting, disaster-relief, immigration control, environmental monitoring and scientific research (West & Bowman, 2016). Drones are considered useful for performing dull, dirty, and dangerous[1] work (Braun, Friedewald & Valkenburg, 2015; Boucher, 2015; Clarke, 2014a; Finn & Wright, 2012; Pauner, Kamara & Viguri, 2015; West & Bowman, 2016).

Drones have been reportedly used for policing, law enforcement, and person-tracking activities since 2006. In the Netherlands, drones assisted in the eviction of people from squats, and were used against cannabis cultivators. Drones were also used against cannabis cultivators in Switzerland. In Canada, photographs of a homicide scene captured by a drone were later admitted in court. In Belgium, France, and Italy, drones monitored undocumented workers, migrants, and demonstrators. In the UK, the first arrest made with the assistance of a drone has taken place in Merseyside (Finn & Wright, 2012).

Drones offer an effective and quick platform for the police in the reconnaissance of emergency scenes, and are often compared with mobile, remotely-managed CCTV cameras (Clarke, 2014a). Concerns are raised, however, by the potential increased likelihood of law enforcement organisations using drones, which were originally designed for military purposes, in civilian domains. The surveillance capabilities also pose a threat to the emergence of 'Panoptic Aloft,' where no violation of rules is ever omitted, with vengeance permeating every level of society (Clarke, 2014a). Additionally, the power of drones questions the legal criteria of expectable privacy, reasonable search by the police, as well as warrant requirements. Certain attempts at crowd control, during demonstrations, by police were considered controversial (Culver, 2014).

Law enforcement activities may extend also to border patrolling. Drones are capable of becoming an integral part of nation states' border-protection (Luppicini & So, 2016, referring to Pozzi, 2014), including land border, coastguard and sea patrol (Braun, Friedewald & Valkenburg, 2015; Hartmann & Giles, 2016; Pajares, 2015). They are already actively used for surveillance on the US-Mexican and US-Canadian borders. Systems deployed, in case of triggered seismic sensors, are capable of locating and, with a laser illuminator, tagging drug smugglers with great success (Finn & Wright, 2012).

Unfortunately, people crossing the border may be subject to the same surveillance measures that are used on criminals (Luppicini & So, 2016, referring to Pozzi, 2014). Such narratives may be especially dangerous in relation with basic human rights, such as migration, which may be endangered by the otherwise legally justifiable requirement to protect a nation state's borders from a military point of view. Drones are especially well-equipped to perform monitoring and, if need be, non-lethal interventions against any transgressors of a nation state's border (Cohn, 2015).

1 Dull is defined by Braun, Friedewald, and Valkenburg (2015) as long-endurance missions requiring long flight times. Dull missions carry the risk of exposure to nuclear, biological, and/or chemical agents for the operator. In military terminology, dangerous missions carry the risk of human exposure to (counter-)air defences (Braun, Friedewald & Valkenburg 2015).

Tijdschrift voor Veiligheid 2018 (17) 1-2
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Drones can significantly empower responsible citizens and vigilantes in their efforts to impose their own morality on others. The appearance of drones may have a negative impact on strangers, minorities, newly-settled refugees, or former criminals in areas with Neighbourhood Watch practices. Voyeurism has been documented by CCTV operators, a behaviour that may be exacerbated with the use of drones. In less extreme situations, drones may also be used for nagging (Clarke, 2014a).

The motives behind the use of drones for security purposes are their value for money, high performance and efficiency, and ability to perform actions in dangerous or uncertain situations (Boucher 2015). It is also common practice for the police to use emerging technologies in secret until the legislation explicitly prohibits the particular use (West & Bowman, 2016, referring to Crump, 2013).

3.3 Legislation and Regulation

As it is unlikely that the use of private drones will be abolished, their use poses significant challenges to the concepts of data protection, information autonomy, and safety (Bendel, 2016; Bracken-Roche, 2016). At the same time, this temporary *lacuna legis* in relation to smaller drones has been recognised as an opportunity, due to the omission of safety requirements imposed on them (Clarke, 2014a). Moreover, the flying of drones illegally is on the rise (Luppicini & So, 2016).

Particular difficulties have been encountered in the development of overarching legislation and regulation of civil and domestic drones, due to its political implications (e.g. freedom of expression, open justice, public safety), as well as the need to update certain definitions (e.g. privacy) stemming from their insufficiency to capture the characteristics of drone technologies (Clarke, 2014b; Finn & Wright, 2012; Luppicini & So, 2016; Pauner, Kamara & Viguri, 2015; Rao, Gopi & Maione, 2016). It can be stated, that various regulations are in place in the US (Finn & Wright, 2012; Luppicini & So, 2016; Rule, 2015; Sandbrook, 2015; Volovelsky, 2014) and particularly by the FAA (FAA, 2015b; FAA, 2015a; Coopmans, 2014; Culver, 2014; Finn & Wright, 2016; Freeman & Freeland, 2016; Hartmann & Giles, 2016; Luppicini & So, 2016; Mohammed et al., 2014; Rao, Gopi & Maione, 2016; Rule, 2015; Volovelsky, 2014), Canada (Gersher, 2014; Luppicini & So, 2016), the UK (Finn & Wright, 2016; Finn & Wright, 2012; Hartmann & Giles, 2016; Pauner, Kamara & Viguri, 2015; Sandbrook, 2015), Germany (Bendel, 2016), Switzerland (Bendel, 2016), Australia (Volovelsky, 2014), and Israel (Volovelsky, 2014).

It has been recognised that the EU legislation does not cover all the issues related to drone technologies (Rao, Gopi & Maione, 2016). However, multiple regulations are already in place, such as the *Charter of Fundamental Right of the European Union* (2000) securing one's privacy and the 'right to be left alone' (Finn & Wright, 2016); the *Data Protection Directive 95/46/EC* excluding households from data processing;[2] and the proposed *General Data Protection Regulation* (Regulation

2 Although authorities and law enforcement agencies are exempt from this regulation (Finn & Wright, 2016; Pauner, Kamara & Viguri, 2015).

(EU) 2016/679) requiring Privacy-by-Design and data protection impact assessment (Finn & Wright, 2016; Finn & Wright, 2012; Pauner, Kamara & Viguri, 2015).

4 Dual-use Dilemmas Regarding Drones

There is a disagreement regarding whether the military origin of drones is a source of safety concern. Luppicini and So (2016) highlight along with Braun, Friedewald, and Valkenburg (2015) that the safety of operating a drone does not constitute a substantial concern in adversarial terrain. However, the issue of drone safety plays a significant role in the civilian context (Braun, Friedewald & Valkenburg, 2015; Luppicini & So, 2016).
The literature highlights the remaining influence of military applications as a driver for drone developments. This is considered as an issue which 'heavily biases the progress into particular directions' (Clarke, 2014a: 231). Braun, Friedewald, and Valkenburg (2015) notes that when technologies migrate from one context to another, concepts related to the original context persist (e.g. narratives, approaches to technological design, or attached notions such as security; (Braun, Friedewald & Valkenburg, 2015, referring to Law, 2009).

4.1 Dual-use and the Military Origin of Drones

Boucher (2015) notes that during the European proposal for demilitarisation of drones, military presence played a significant role in its development of the proposal. During the EC consultation period, the idea of reverse relationship (i.e. when the military domain will benefit from re-adapting innovations developed in civil domains) was considered from the beginning of the hearings (Boucher, 2015).
In the following high-level group conference *inter alia*, two statements were agreed on. First, the European framework should favour dual utilisation of drones ('Conclusions of the First European High Level Conference on Unmanned Aircraft Systems' 2010). Second, that military representatives would be part of the high-level group to ensure that this dual nature of drone operations is addressed from the beginning (Boucher, 2015; also see 'Conclusions of the First European High Level Conference on Unmanned Aircraft Systems' 2010). The relationship between the civil- and military-drones was called 'mutualisation' in one of the working group documents (Boucher 2015), before the publication of the final ('Roadmap for the Integration of Civil Remotely-Piloted Aircraft Systems into the European Aviation System' 2013).
Boucher (2015) notes that co-operation between military and civil domains is nothing new. The novelty is in the involved cooperating market domains. Instead of the weaponry market traditionally related to arms, it is the market of electronics that is now involved in the mutualisation of civil and military drones. In Europe, this convergence is linked with an effort to secure a better military position, closing any gaps in the global arms races (Boucher, 2015), citing (Clouet, 2012). This fusion of military and civilian interests is recognised also by Bracken-

Tijdschrift voor Veiligheid 2018 (17) 1-2
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Roche (2016), who express their concerns regarding a dangerous complementarity of governmental and corporate needs, which results in placing the interests of the public good in the background.

The migration of drone contexts from military to civil domains affects the public vision and acceptance of drones ('Roadmap for the Integration of Civil Remotely-Piloted Aircraft Systems into the European Aviation System: Annex 3. A Study on the Societal Impact of the Integration of Civil Rpas into the European Aviation System' 2013). According to the ERSG, the 'killing machines' vision of drones needs to be transformed ('Roadmap for the Integration of Civil Remotely-Piloted Aircraft Systems into the European Aviation System: Annex 3. A Study on the Societal Impact of the Integration of Civil Rpas into the European Aviation System' 2013). Such transformation should occur by adjusting strategies for public communication, focusing on functional benefits of drones (e.g. robot helpervision), as well as their economic benefits (e.g. drones as the new iPods). Communication with the public should, for example, abstain from using the word 'drone' (cf. the issue of 'd-word' shifts the language from technical specifications towards practical applications and use (Boucher, 2015).

Additionally, drone enthusiasts may themselves provide support for maintaining military themes and narratives regarding drones. Enthusiasts may be interested in drones for self-defense, to fulfil certain militarist fetish, or to engage in rogue activities (Boucher, 2015).

A greater concern regarding the dual-use of drones is expressed in the blurring of the lines between public and private, military and civil spheres (Finn & Wright, 2012; West & Bowman, 2016). Firstly, the emergence of cyberspace supports the development of cyberpower, which does not remain in the virtual world but has become a new and real form of military force between states (Hartmann & Giles, 2016). Secondly, the persistent connection between military and civil realms in drones impedes the clarification of the effects of such technology on individuals' right to privacy (Volovelsky, 2014). Thirdly, blurring the distinction between military and civil contexts gives rise to novel inter-organisational relationships (Klauser & Pedrozo, 2015), the effects of which on civil liberties have not been investigated exhaustively. In Europe, law enforcement and security demands have been given clear preference over civil liberties concerns if one considers that drones are used and deployed in multiple law enforcement and other units since 2006, while very little discussion has been conducted regarding their effects on marginalised populations (Finn & Wright, 2012).

4.2 Low Priority of Privacy Concerns

The military origin of drones also has consequences in terms of the low priority of privacy concerns. Privacy is not an important issue in military operations, however it is important in civil life. Nevertheless, it has been noted that, as a consequence, drone use in the civilian context also has a low priority of privacy concerns (Braun, Friedewald & Valkenburg, 2015). Braun, Friedewald, and Valkenburg (2015) note that the lack of focus on privacy is evident in drone development and design, with 5 out of 6 developers confirming that privacy is not one of their deliverables, nor is it explicitly required by their customers. Moreover, man-

ufacturers often supply both military and civil drone customers, with functionalities and patterns of civil drones that are similar to those of military drones. This poses difficulties in finding solutions for customers who have alternative (i.e. non-military) requirements (Braun, Friedewald & Valkenburg, 2015).
The task of implementing privacy-sensitive solutions is thus usually not an integral part of the design process and is 'retro-fitted,' rendering their implementation into the actual design of drone cumbersome (Braun, Friedewald & Valkenburg, 2015).
Finally, Boucher (2015) emphasises that such a close inter-dependence of military and civil domains in European drone development is controversial, in terms of conflict with its own Responsible Research and Innovation standards. In particular, the management of public strategies towards greater acceptance of drones is 'disingenuous' (Boucher, 2015, 1408; Boucher, 2016, 1393). On one hand, public concerns are admitted (e.g. 'killer machines' vision), while on the other hand, full consideration of all consequences of drone-development are rejected (e.g. privacy). Such a stance is not in accordance with responsible and transparent innovation (Boucher, 2015; Boucher, 2016).

4.3 Killing Machines

The image of drones as killing machines is one of the central assumptions of ERSG, an image which, they argue, has to be tackled with more positive depictions and coverage of drones in the media ('Roadmap for the Integration of Civil Remotely-Piloted Aircraft Systems into the European Aviation System: Annex 3. A Study on the Societal Impact of the Integration of Civil Rpas into the European Aviation System' 2013). However, Boucher (2016) questions this narrative, finding little evidence for such a negative assumption. The military context is seen rather positively in the study conducted by Boucher (2016), recognising the life-saving role of drones, especially in search and rescue operations. The threat that was recognised by study participants was the prospective abuse of drones by terrorists (Boucher, 2016). The study participants first impressions of drones are largely influenced by direct experience, and less so by the media and TV reports. The main contributors to the negative picture of drones in the study were identified as recreational drone users and hobbyists (Boucher, 2016).
The results of this study not only questions the rather disingenuous strategy of the ('Roadmap for the Integration of Civil Remotely-Piloted Aircraft Systems into the European Aviation System: Annex 3. A Study on the Societal Impact of the Integration of Civil Rpas into the European Aviation System' 2013) in influencing the public perception of drones (Boucher, 2015). It also questions the issue of the 'd-word' (Boucher, 2015), an issue that could not be confirmed by another study (Lidynia, Philipsen & Ziefle, 2017).
The frequently raised objection linked with drones stems from their military origin, namely, that drones endorse a 'Playstation mentality' (Finn & Wright, 2012; Finn & Wright, 2016). This concept describes a supposed computer game attitude of drone operators during military (killing) missions, significantly contributing to the dehumanisation of those impacted by the drone. It is feared that a similar attitude may be perceived in the groups of border protection forces (Finn &

Tijdschrift voor Veiligheid 2018 (17) 1-2
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Wright, 2012), referring to (Hayes, 2006). The concern of the continuity of military contexts in non-military drone operations is also expressed by Sandbrook (2015), for example, in opinions such as equipping drones, which are used to protect wildlife from illegal hunters, with weapons.

4.4 Limitation of Civil Liberties, Acceptability of Drones

Drones raise substantial concerns regarding the limitation of current civil liberties by (private or state-led) law enforcement agencies (Finn & Wright, 2012), referring to (Nevins, 2011). There are not only doubts about the goal of providing greater homeland security but also about the means by which this is reached: general surveillance, when everybody is monitored, tracked, recorded, and possibly can be targeted (Finn & Wright, 2012), referring to (Whitehead, 2010). The issue with general surveillance lies mainly in its narrow sensitivity for details. Even if those details are captured, it may increasingly incline towards enforcing the law against illegal or illicit actors, rather than protecting the rights and entitlements of all actors (Finn & Wright, 2012), citing (Wall & Monahan, 2011).

The public and ethical concerns and dissatisfaction regarding drones in relation to civil rights and liberties is further strengthened by issues such as illicit discrimination, consequences of the 'chilling effect,' 'function creep' of drones, and dehumanisation (Boucher, 2016; Finn & Wright, 2016; Lidynia, Philipsen & Ziefle, 2017).

Multiple studies and polls confirmed the strongly held opinion of participants that the general accessibility of hobby aerial robots is not favoured. Therefore, for private use of aerial robots, strict regulation is preferred (Boucher, 2016; Finn & Wright, 2016; Volovelsky, 2014; West & Bowman, 2016).

It may be argued that the easy accessibility of consumer aerial robots for enthusiasts is justifiable based on their fun-element, which fulfils common desires (e.g. fascination with technology, playful flying, capturing images). Bendel (2016) identifies that the benefit of recreational aerial robots is for pleasure. However, Lidynia, Philipsen & Ziefle (2017) report that aerial robot-users considered issues of privacy, identifiability of the purpose of aerial robots based on its appearance, less important compared with non-users. Clearly, the benefit originating from pleasure is less important than the risk towards privacy and civil liberties. Moreover, the general argument supporting the use of aerial robots is that it is a safety-enhancing technology compared with manned aircraft. Disregarding risks towards human rights and civil liberties should be considered as attempts to diminish safety in relation of aerial drones. Personal preferences of aerial robot-users and market interests of the aerial robot industry do not provide the equivalent strength of the argument that facilitates the disregard of (non-users') reservations regarding human rights and civil liberties violations.

The issue of the identification of aerial robots emerged in relation to humanitarian aerial robots (Emery, 2016). However, the issue of identification in relation to the acceptability of aerial drones received little attention in the reviewed literature. Addressing this issue, after detailed scrutiny in empirical studies, may increase the overall acceptability of aerial robots by the general public.

Additionally, aerial robots are ideal platforms for 'individuals and groups seeking to impose their own morality on others' (Clarke, 2014a, 241). Such eventual use, either by 'vigilantes' or terrorists, substantially challenges the acceptability and general availability of consumer drones for recreational users.
Finally, disturbance to the environment and wildlife caused by aerial robots also weakens the arguments supporting the accessibility of aerial robots for a large number of hobbyists.

5 Discussion

The emergence of novel sensor technologies with the miniaturisation of batteries and computing hardware has enabled the development of flying machines (drones) that are capable of (semi-)automatic hovering, with much smaller input from the human operator (pilot) than ever before. Moreover, drones are capable of carrying a wide variety of payloads, making this device ideal for providing robotic support in dirty, dull, and dangerous operations, or conducting monitoring and surveillance missions.
However, the emergence of drones and drone technologies is related to controversies and ethical dilemmas since its introduction. Precision killing may on one hand save many lives by avoiding the need to send armed men to a military mission, but on the other hand, it is hard to justify in the context of missions that are not defensive.
The interest of governmental agencies in such a powerful and capable technology is somewhat understandable. Nevertheless, the lack of regulation and lack of requirement for transparency regarding the operation of drones in civilian contexts may trigger further controversies and ethical dual-use dilemmas for drone operators, as well as the citizens of democratic societies.
The increasing number of joint research and other initiatives embracing military and civilian aims, as highlighted by Boucher (2015, 2016), may be identified as an additional source of dual-use dilemmas that need to be resolved.
With these potential sources of dual-use and ethical dilemmas, we should recognise the opportunity to act responsibly and proactively in averting the very possible harms that could be inflicted due to misuse and malevolent use of drones and drone technologies. Alternative models for assessing these risks and opportunities during R&D as well as implementation of drones and drone technologies should be explored, including key stakeholders, such as, the military, governmental bodies, hobbyists/enthusiasts, and most importantly the general public. Educating and engaging the public regarding the responsible and beneficial R&D and use of drones and drone technologies offers us a chance for developing a framework that truly assesses and addresses the key concerns of the general public, arguably the most important stakeholder, regarding the dual-use of drones. Moreover, this putative framework would also feed into improving RRI and VSD of drones and drone technologies.

Tijdschrift voor Veiligheid 2018 (17) 1-2
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6 Conclusion

This paper highlights the critical importance of ethical dual-use issues with drones and drone technologies. Assessing and addressing these issues is key, not only for public acceptance of drones, but also for responsible use of drones, in such a way that benefits individuals and societies.
These goals can be achieved by fulfilling the four general principles applicable to dual-use dilemmas: social responsibility of the researchers, 'no means to harm' principle, scientific freedom, and collective responsibility for dual use (Barazzetti, Diezi & Benaroyo, 2015). As demonstrated, especially the last two principles is critical to fulfil in joined military-commercial endeavours and projects to avoid controversies that may harm any of these two stakeholders.
These principles may be expanded by additional principles such as greater transparency. The principle for transparency is essential for conducting responsible innovation in non-military domains. If military stakeholders favour the collaboration with non-military partners, it should adhere to the high ethical standards of transparency towards its partners and the public, otherwise all the stakeholders risk controversies and negative consequences in the form of whistleblowers, eventually mass resignation of employees.
For non-military researchers it is crucial to maintain good relations with the public, as the public sphere is the ultimate source of research funding. If research communities lose the essential support from the public, either due to opaque relations with military stakeholders or questionable objectives, it may have long-term negative consequences for the researchers themselves. Therefore, it is crucial that researchers from the public or commercial spheres collaborating on projects with military stakeholders insist on the ethical requirement of transparency, as this is beneficial and responsible for all parties involved.

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