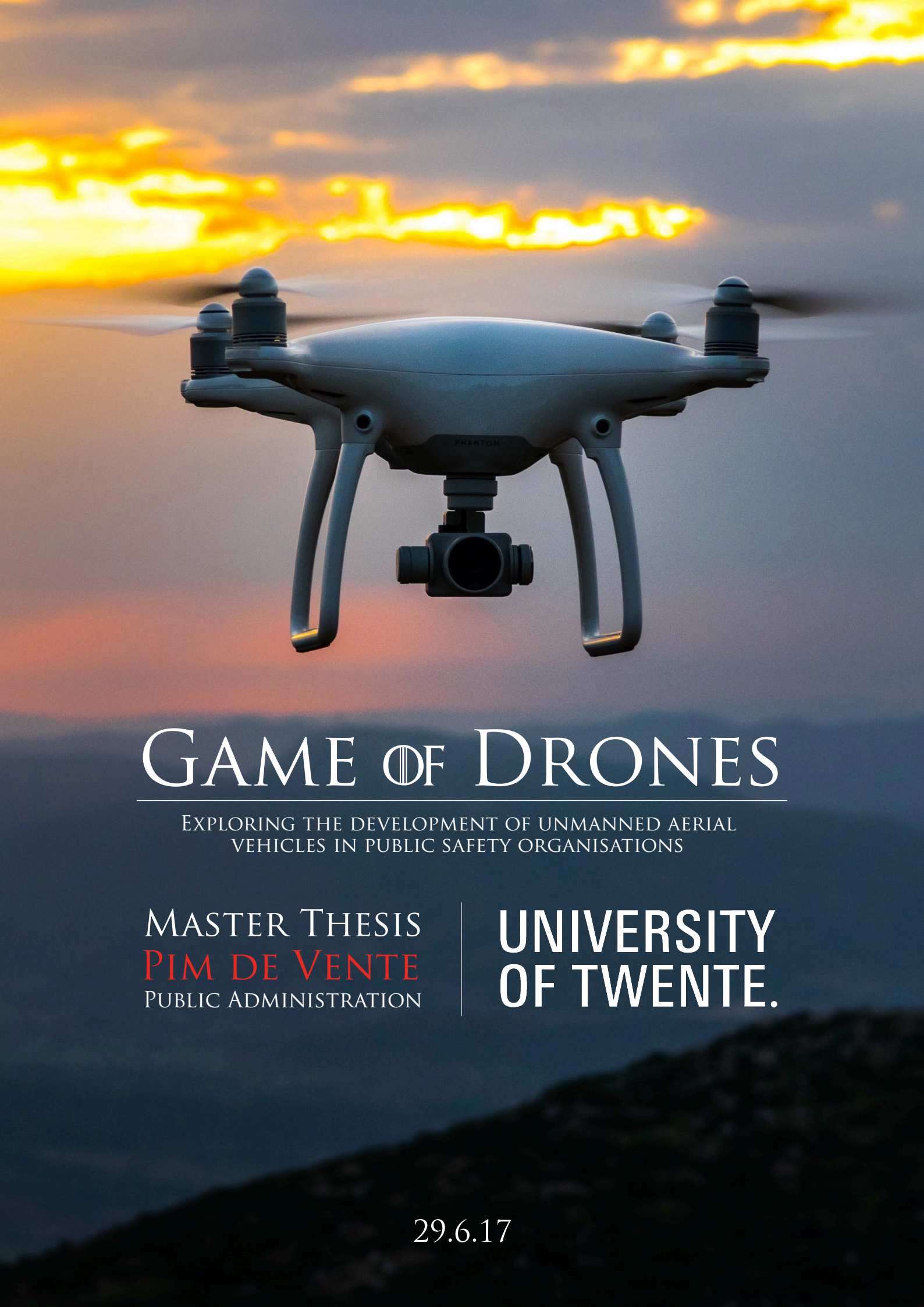

Game of Drones

Exploring the development of unmanned aerial vehicles in public safety organisations

Master Thesis
Pim de Vente
Public Administration

University of Twente.

29.6.17

Game of Drones

Exploring the development of unmanned aerial vehicles in public safety organisations

by Pim de Vente

A thesis submitted in partial fulfilment of the

requirements for the degree of Master of Science in

Public Administration - Regulation and Innovation

Faculty: Behavioural, Management and Social sciences

University of Twente

June 29th, 2017

Supervisors:

Dr. A.J.J. Meershoek

Prof. dr. M.A. Heldeweg

Summary

The innovation of unmanned aerial vehicles (UAVs, or: drones) entails many opportunities and uncertainties. It is important for public safety organisations to learn how to work with drones in their own law enforcement operations. This study has made a contribution to understanding which elements are influencing the learning process and how state actors can incentivise or (unintentionally) discourage the process of further UAV innovation. Specifically, the following research question has been addressed: *how could actors improve the learning process of working with drones in a public safety domain?*

By analogy, a 'game of drones' is introduced in this study to illustrate the political and societal debate about uncertainties associated with drone-related technology. This study has explored a socio-technical playing field in which these discussions and the learning process of actors are important dynamics. In eight semi-structured interviews, nine respondents in Dutch national police and fire department were asked to present their views about technological performance, societal embedding and opportunities and challenges regarding the drone innovation. The results of this study have shown that actors are effectively and constructively working together to learn about the functionalities of drones - in relation to the attention drones receive in (international) media. In two experimental projects, actors are treating drones as an addition to the armoury, rather than replacing the existing surveillance devices. Drone implementation is furthermore carefully introduced in other parts of the organisation. In light of this study's results, it can be concluded that actors not only learning to work with drones, but are also investing in the relations in the *maatschappelijk krachtenveld* of drone development. Still, this study show that there are undesirable aspects in the learning process that affect the implementation of drones, such as: (1) an unscheduled extension of the projects; (2) a focus on solving practical issues rather than the uptake of drones in society; (3) not actively pursuing future opportunities of the drone technology; and (4) no direct state monitoring and evaluation. The results indicate that the experimental projects provide a lot of new information of and understanding about the use of drones. However, the problems encountered by the actors are often difficult to solve by the actors alone. Although the project actors are primarily focused on overcoming practical challenges, they do not contribute to the next step in the development of drones nor are they proactively adapting to their future functionalities.

This study has proposed three different scenarios in which governmental intervention is directed at project actors. State actors can (1) opt not to intervene; (2) conclude that the projects have failed and strictly monitor the projects; or (3) encourage the project actors to pursue their interest in formulating performance requirements for future safety operations (e.g. by providing additional funds or by creating general legal exemptions for additional experimentation). The third scenario would be the most productive, since it will support the project actors in their learning process while retaining the obtained knowledge. Drones are here to stay- the question to be asked is whether improved dynamic interactions between state actors, police and fire department can ensure drones will be handled productively and legitimately.

Samenvatting

Door de onzekerheden die de innovatie van onbemande luchtvaartuigen (beter bekend als 'drones') met zich meebrengt, is het noodzakelijk voor actoren te leren omgaan met drones ten behoeve van de dienstverlening in de publieke veiligheidssector. Dit onderzoek heeft een bijdrage geleverd aan het inzicht over welke elementen het leerproces beïnvloeden en hoe de overheid het proces van verdere drone-innovatie kan stimuleren of kan ontmoedigen; bedoeld of onbedoeld. De volgende onderzoeksvraag is daarbij gesteld: *hoe kunnen actoren verbeteringen aanbrengen in het leerproces om te werken met drones in een publiek veiligheidsdomein?*

In dit onderzoek wordt bij wijze van analogie een 'game of drones' geïntroduceerd; hiermee wordt het politieke en maatschappelijke debat over onzekerheden van drones geïllustreerd. Dit onderzoek richtte zich op het in kaart brengen van het maatschappelijk krachtenveld waarin de discussies en het leerproces van individuen belangrijke onderdelen van de dynamiek zijn. Middels acht semi-gestructureerde interviews werden negen respondenten uit de Nederlandse Politie- en Brandweerorganisatie gevraagd hun visie te geven op technologische prestaties, maatschappelijke inbedding en diverse mogelijkheden en uitdagingen met betrekking tot onbemande luchtvaartuigen. De resultaten van dit onderzoek hebben aangetoond dat actoren effectief en constructief samenwerken in het verzamelen van kennis over functionaliteiten van drones in relatie tot de aandacht die drones krijgen in (internationale) media. De benaderde vertegenwoordigers uit twee experimentele projecten zien onbemande luchtvaartuigen als aanvulling op het huidige arsenaal in plaats van een vervanging van bestaande middelen zoals camera's. Drones worden al voorzichtig geïntroduceerd binnen andere onderdelen van de organisatie. De resultaten van dit onderzoek leiden tot de conclusie dat actoren niet alleen met drones leren werken, maar dat zij ook bereid en in staat zijn te investeren in onderlinge relaties in het maatschappelijk krachtenveld van de drone-ontwikkeling. Uit dit onderzoek is gebleken dat ook ongewenste aspecten in dit leerproces de implementatie van drones beïnvloeden, namelijk: (1) een onvoorziene verlenging van de projecten; (2) een focus op het oplossen van praktische problemen in plaats van de maatschappelijke inbedding van drones; (3) het niet actief nastreven van mogelijkheden voor drone-toepassingen in de toekomst; en (4) geen directe monitoring en evaluatie door de overheid. Dit onderzoek heeft aangetoond dat de experimentele projecten veel nieuwe inzichten bieden over het gebruik van drones en dat het daarentegen lastig is voor actoren om problemen die ontstaan, zelfstandig te kunnen oplossen. De projectactoren zijn gericht op het overwinnen van praktische uitdagingen, maar tegelijkertijd leveren zij geen zichtbare bijdrage aan de volgende stap in de ontwikkeling van drones, noch zijn ze proactief in het nastreven van toekomstige functionaliteiten.

Dit onderzoek stelt drie verschillende scenario's voor waarbij overheidsinterventie gericht is aan de projectactoren. De overheid kan (1) ervoor kiezen om niet in te grijpen; (2) concluderen dat de projecten zijn mislukt en dat er strikte afspraken moeten worden gemaakt; of (3) de projectactoren aanmoedigen hun belangen na te streven met betrekking tot het formuleren van prestatie-eisen voor toekomstige dienstverlening, bijvoorbeeld door extra subsidie te verstrekken of door een algemene wettelijke vrijstelling te creëren voor aanvullende experimenten. Het derde scenario zou het meest productief zijn omdat de projectactoren worden ondersteund in hun leerproces en de reeds verworven kennis niet verloren gaat. Drones: ze zullen een belangrijke rol krijgen in de samenleving. We moeten onszelf de vraag stelen of de huidige verbetering van de dynamiek en interactie tussen overheid, politie en brandweer, voldoende waarborgen biedt voor optimaal gebruik van drones in productieve en legitieme zin.

Preface

This thesis is a final work as partial fulfilment for the degree of Master of Science in Public Administration in Faculty Behavioural, Management and Social Sciences at University of Twente, titled: 'Game of Drones - Exploring the development of unmanned aerial vehicles in public safety organisations'.

I would first like to acknowledge my supervisors, dr. Guus Meershoek, and prof. dr. Michiel Heldeweg for their enthusiasm, support, recommendations for literature and books, introducing me to several researchers and representatives, and for inviting me to interesting events and seminars. Next, I would like to thank prof. dr. Arie Rip for his literature suggestions and his advice for improving my academic writing skills. Furthermore, I am very grateful for the support by my parents and their spouses, my brother, my girlfriend, my family, (ex-)roommates, friends, and colleagues. Additionally, I would like to express my gratitude to Ben Kokkeler, Matthijs Moorkamp, Haomiao Du, Irna van der Molen, Casper Steenstra, Martijn Zagwijn, Barend van der Meulen, Niki Gollenbeek, Floortje Jolink, Alex Kamphuis, Iris Huis in 't Veld and Harm Albers for our communication for the benefit of this thesis. It has been a great pleasure working with all of you.

I hope you will enjoy reading this thesis.

Sincerely,

Pim Julius de Vente

June 29th, 2017,

Enschede

Table of Contents

1
Introduction

Our society is evolving. Modes of transportation are increasing, the 'internet of things' and mobile communications define our daily lives and electronic products are entering our social domain. Public organisations are looking into the possibilities of applying emerging technologies and innovative systems into their operations. One of these emerging technologies is remote piloted aircraft systems (RPAS) or unmanned aerial vehicles (UAVs[1]), more commonly referred to as 'drones'. These aircraft systems come in different shapes, from small model aircraft made by hobbyists to airliner-size military drones. Although drones have been around for some time, their development has increased rapidly over the past years. Out of many emerging technologies, drone technology is interesting from a public administration perspective since there are several actors and organisations that are learning to work with drones, and all sorts of regulation that do not necessarily cover all aspects of the drone innovation. This poses a risk and is promising at the same time. Public safety organisations are able to implement camera-equipped surveillance drones in their safety operations, but at the same time the rules for recreational use will need to be enforced by these same organisations[2]. In the Netherlands, regulation for recreational drone use is already being established, which is linked to regulation for model airplanes[3]. In the case of emerging technologies, there are certain promises, requirements, and rules. Still, a camera-equipped drone brings tensions related to privacy and data protection, which require different types of regulatory regimes. Public safety organisations have the opportunity for improving law enforcement operations, but also need to be aware of recreational and malicious use.

The way public safety organisations are positioned in the dynamic development of drones can be characterised as a game. In economics and political science, the notion of 'game' is associated with 'game theory' and entails rational choice and actor movement in modeled realities. With rational choice approaches, players know their interests and know the rules. One can assume how to bet their own actions to optimise their position. Rational choice approach can however not be applied directly here, since this assumes all rules are known. In political science, game theory relates to bargaining, public choice and fair division. Rip (1992) introduced a similar notion in science and technology studies (STS): "actors developing technology (...) create relationships to stabilize their search processes and enhance their chances of success (...) [and] it becomes clear that such patterned relationships are coupled to a repertoire of shared rules, and that one can speak of (strategic) games"(p. 53). For the purpose of this research, this study introduces a game of drones, played out in a dynamic field in which several state and non-state actors are experimenting with RPAS technology and are working towards an optimal deployment.

[1] in this study, the terms *RPAS*, *UAV*, *drone* and unmanned aerial system (*UAS*) will be used interchangeably

[2] as illustrated by (Finn, Rachel L; Wright, David; Jacques, L; De Hert, P 2014)

[3] (Regeling Modelvliegen, 2017)

2
Research project

2.1 Approach

In order to examine the rules of the game of drones, this study aims to characterise the dynamics of a socio-technical 'playing field' in which public safety organisations are operating. As is the case with games, there are certain rules, roles, relations between players, and winning strategies: elements which exert pressure on actors playing this game. Since the innovation of drone-related technology is uncertain and not well-understood, this study aims to look at the learning process of actors in the socio-technical playing field. By doing so, this study can recommend actors in a public safety domain to improve the learning process of how to work with drones. The question of better deployment has been addressed in so-called constructive technology assessment (CTA). For example, for the domain of nanotechnology, scenarios about possible further development and embedding in society have been created[4]. With drones, the structure of the technology is already quite articulated. What is novel, are the functionalities to be addressed in present technology and how these work out in organisations and in society in general. There has been philosophical attention to these questions with a focus on ethics of drones[5]. What is lacking, is empirical research of the dynamics in this development in concrete situations. There is a need to do so because the implications of the technology are not yet clear (e.g. concerning liability and security issues), while actors are already working with drones, and learning by doing. Mapping what is going on at the present is already an important contribution - some of the activities and the learning involved are not very visible. Finding out about patterns in the embedding in society, starting with directly concerned organisations -like public safety organisations- will allow considering future developments and questions or tensions that may arise.

Presently, public safety organisations are experimenting with drones for daily operations[6], and they are thinking about ways of dealing with novel sensing devices[7]. Their learning might lead to new practices and rules that guide them, up to regulations (and as this study will show, manuals). This is played out in already existing organisations, practices and regulations. Such learning can be traced empirically by asking actors about it. An additional point is how well articulated and stabilised such learning becomes in terms of outcomes. The latter can be traced by noting the modalities of the statements actors use when discussing practices, organisational approaches and responsibilities, and the status of the new technology. Analysis of modalities used by actors in their statements has been done for scientific statements about facts and theories, which can range from

[4] (Parandian, Alireza 2012)

[5] (Jansen, P.H. 2015)

[6] i.e. surveillance of people, civil protection and regulatory enforcement, in: (Finn, Rachel L; Wright, David; Jacques, L; De Hert, P 2014)

[7] (Politie; Ministerie van Veiligheid en Justitie 2015)

speculation, very uncertain, to possibly the case, to generally accepted[8]. Similarly, one can find out how confident actors are about the technology, its functionalities and their embedding in society, as well as how strong actors feel about organisational mandates and responsibilities. Since this is a novel approach for public administration studies and organisation studies, I will briefly discuss modality analysis before I formulate my research question and additional sub-questions. "The movement from socio-technical promises to more or less functioning objects"(Bennertz, 2014, p. 47)[9] is captured in the modalities that are used to speak about them- just as in discourse from "scientific claims to facts"(p. 47). They are part of the dynamics of ongoing development and embedding in society. For example, by characterising something as self-evident, and when there are no objections, it gains further power and its meaning stabilises. It is not just an attempt to extent rhetorical power, however. Objections can be taken up and thus advance the learning process about working with the technology. Objections can lead to debate and sometimes controversy, and then force further articulations (i.e. learning). In other words, modalities that actors use are an empirical entry point to find out about the solidity of claims in practice and about how actors can permit themselves to present them.

Since actors in public safety organisations are key actors exploring the application of drones, and might well be at the forefront of learning how to handle them in practice, they are a good site to study the evolving game of drones. In particular, one can find out what sort of learning is now happening and explore how the leaning could be done better. Thus, the following research question can be formulated for this study:

How could actors improve the learning process of working with drones in a public safety domain?

This study's central research question assumes there are multiple actors and interactions in the public safety domain and that actors are learning about working with drones. Learning is not just a technical question about performance of technology, but also an organisational question on how actors will adapt based on learning experiences. Moreover, learning is about the process of gaining insights and experiences in the broadest sense of the word, including dedicated organisations. The focus in this study is on actors in public safety organisations, since they are directly confronted with practical and organisational issues. As to my knowledge and for the case of drones, there have been no studies that explore the learning process of actors in the public safety domain, nor any that make recommendations for improvement.

2.2 Sub-questions and set-up of the thesis

The first sub-question (Ch. 6.1) to be addressed is: *which actor groups can be distinguished in the innovation of RPAS for public safety purposes?* By interviewing actors from these groups, the second sub-question (Ch. 6.2) can be addressed: *how are actors viewing the emergence of drones and what implications do drones have in the public safety domain?* This question also refers to the modalities the actors use, since they describe they way drones are treated by the actors. Next, a third sub-question (Ch. 6.3) can be addressed: *how are experimental RPAS projects constructed, monitored and evaluated?* This question is not just about project monitoring and evaluation in general- it also addresses technology assessment aspects, in particular the development and embedding in society

[8] cf. *Ladder of Facticity* as analysed by (Latour, Bruno; Woolgar, Steve 1979)

[9] also illustrated by (Robinson, Douglas; Ruivenkamp, Martin; Rip, Arie 2007)

of the new technology of drones. This can be brought out by adding a specific question: *to what extent are technological performance and societal embedding relevant for public safety organisations?* This can be traced by checking how strong the modalities are in talking about actual and potential technological performance, and about desirable and actual societal embedding.

In addition to the four mainly descriptive sub-questions, further analysis is possible. For example, one aspect of the analysis is exploring the need to be specific in operating guidelines while also keeping room for professional discretion (Ch. 4.4) - an issue that is visible in the interviews with the actors. Such issues link up with general questions of organisations and public administration studies, but in this study they are not derived from these disciplines. Instead, they have been identified as recurring patterns in how actors in public safety organisations work with drones. Such patterns cannot be observed directly, but they relate to how actors talk about drones, how they report about their work and how they voice their concerns. They are inferences by the analyst, but supported by various empirical data. Thus, there is a fifth sub-question (rather: theme), which will be addressed in Ch. 6.5: *what patterns can be found in public safety organisations, and what do these patterns show about ongoing learning about RPAS?* The overall research question talks about 'improving learning', an important issue already visible in this fifth sub-question. It can be emphasised further by referring to a classical theme in public administration: the role of the government and its possible interventions. In Ch. 6.6, this then is addressed by asking: *how can state actors incentivise or (unintentionally) discourage the process of future RPAS innovation and its embedding in society?* Rather than drawing on the large general literature on this theme in public administration studies, I will remain close to my topic, the game of drones, and consider possible situations in scenarios, depending on the nature and extent of state intervention.

The overall approach of this thesis differs from a classical public administration thesis in its interest in what is happening with drones, in particular in the domain of public safety and its organisations. Thus, I start (Ch. 3) with presenting the current view on RPAS and the current development of RPAS in public safety organisations (including experimental projects). Only after this intermezzo (itself a result of this study), the Literature chapter (Ch. 4) is selective in explaining several concepts related to the analysis of technology development and its embedding in society. It is followed by a brief indication of the approach and design for the study's methodology and the methods for data collection (Ch. 5). In Ch. 6, the findings of this study are presented. They are followed by Conclusions and discussion (Ch. 7) which will offer further consideration about how the learning process occurs, limitations to this study and recommendations for further research, and propositions on how the learning process could be improved if project actors and state actors will make additional moves. The thesis will conclude with bibliographic references (Ch. 8) and an Appendix (Ch 9) containing a glossary (App. I) and tables and figures (App. II).

3
Drone development

3.1 Opportunities and challenges

The development of unmanned aerial vehicles (UAVs) entails opportunities in practical areas. As opposed to the relatively densely populated Netherlands, the United States' geographical area provides more space for aerial experimentation and for the past few years, there have been several studies and examinations by both end users and scholars. In Pittsburg, home to recurring experimentation with emerging technologies[10], scholars[11] outlined eight different opportunities for UAV use: geo-spatial and surveying activities, civil security control, traffic and crowd management, natural disaster control and monitoring, agriculture and environmental management, urban security increasing the city's attractiveness, big data collection and coordination between heterogeneous systems. While their research focused on the application of UAVs in smart cities, some of these elements can be found in other studies as well. In the same year, Freeman (2014) described that for agricultural UAS expansion, political activity and lobbying should follow the "enthusiasm over the economic development potential"(p.307) and the media coverage in other nations where there is less restriction and more permission. He presses that the uneasiness with UAS systems is "based in large part on the highly publicised UAS involvement of the U.S. War on Terror"(p.309), which is quite the challenge for RPAS. While these studies have shown several examples of UAV application, UAVs also bring opportunities for construction work, non-destructive testing, advertising, parcel delivery, search and rescue, and exploration.

Beside opportunities, several challenges have been addressed in academic literature and reports, such as legal and regulatory design challenges, threats to privacy, data protection issues and ethical considerations. The first and also fairly persisting challenge concerns whether existing regulation can cope with challenges concerning the increasing capabilities of drones, the improvement in usage, and the autonomous character. Clarke (2014), a professor on cyberspace law and a consultant for government agencies, presents a rather critical view on this challenge. This view is reflected in the way he addresses elements of the development. He stresses the concepts of 'airworthiness' (p. 232) and suitability for safe flight, autonomous control, supporting infrastructure, and the decreasing role of humans as direct operators. For risk management, he argues, there needs to be careful consideration for defining what a drone actually is and what the expectations are for each type. In the first of a series of four articles, he concludes that large drones are not the problem, since they are relatively similar to manned aircraft vehicles regarding regulatory frameworks, manufacturing, maintenance, and piloting. "Critically, however [Clarke adds], the same does not apply even to mini-drones, let alone to the burgeoning population of micro-drones and the rapidly-emergent category of nano-drones"(p. 244). Following two follow-up articles,

[10] Hook, L. (2016). Uber launches first self-driving taxi fleet.

[11] (Mohammed, Fihri; Idries, Ahmed; Mohamed, Nader; Al-Jaroodi, Jameela; Jawhar, Imad 2014)

Clarke's (2014) perspective on drone development can be further characterised as doubtful towards the development, by the use of phrases such as 'disbenefits and risks', 'unstructured decision-making', "applications of drones [that] threaten (...) personal, social, economic and political behaviour"[12] and "negative economic impacts, such as job displacement and (...) the distribution of income (...) negative environmental impact"(Clarke, Moses & Bennet, 2014, p. 264). Their dismay on UAV development in Australia, particularly on supporting regulatory regimes, is then found in their view that self-regulation of organisations and industries is "unlikely to contribute much towards a satisfactory regime"(p. 300), that co-regulation is attractive yet unsatisfying and that formal regulation is essential.

3.2 Drones in an international context

George R.R. Martin's 'A Song of Ice and Fire'[13], as popularised by HBO's award-winning television series 'Game of Thrones'[14], tells a story about converging and contrasting political views. Setting aside the play on words in the title of this study - by analogy, a 'game of drones'[15] can provide a characterisation about different political views by exploring different actor relations in a socio-technical field of forces (i.e. 'playing field'). One aspect in this exploration is finding out which parties are role-players in the playing field and which way the drone innovation is headed. In light of the attention in the media, there has been a shift in focus in the past few years about what a drone is, what people think about them and how actors are approaching drone innovation in different ways. Some actors are in charge of decision-making, informing and regulation. Other actors are discussing the innovation, asking about its development or criticising the innovative process. Some actors are developing, researching, designing, and experimenting with the devices. All of these different actors are handling drones in a different way, but they share one claim: however promising the drone technology is, there is an uncertainty about how drones should be treated in legal and social domains[16].

The impact of the drone innovation in international public and political debate could be ascribed to the US' military use of RPAS. The development in the past few years have shown a transition from military drone strikes to "annoying, messy and super-finicky"(TheEconomist 2017) smartphone and radio-controlled model aircraft for hobbyists. But how are different countries approaching this transition? In the United States, there have been several reports about drone strikes- unmanned aerial vehicles were related to targeted killings. In response to the discussion about counter-terrorism operations, a recent study found that only one fifth of drone strikes were acknowledged by the United States[17], while the study reports that for eighty percent of drone casualties, the United States have not been claimed responsibility or provided additional details. In response to the media attention in the US, the European Parliament (EP) decided on a joint motion for a resolution on the use of

[12] (Clarke, Roger 2014, p.260)

[13] (Martin, George RR 1996)

[14] (Benioff, David; Weiss, Daniel Brett 2011)

[15] the popularity of this title is also present in (Vandersteen, Willy 2017)

[16] also illustrated by the Collingridge dilemma (further reading in Ch. 4.3)

[17] (Murtaza Hussain 2017)

armed drones[18]. Furthermore, in June 2017, the European Commission (EC) published a press release document which introduced a 'blueprint' "to make drone use in low-level airspace safe, secure and environmentally friendly"[19], focusing on four phases of a regime for drone regulation in 2019. The four phases respectively introduce registration and identification for pilots and vehicles; air traffic management and control; complex drone operations in densely populated areas; and employing the full capacity of the *U-Space* (i.e. physical flight space).

Media reports and studies from the past few years primarily focused on the impact of future drones, which were primarily inspired by the discussion about its military functions. Following the analogy with conflicting opinions between actors, one could refer to 'war' as a pattern in the past few years. In the United Kingdom (UK), a website dedicated to informing and commenting on use of drones carries this notion of 'war' and mentions some instabilities about drones: "making it easier for politicians to opt for war" (...) video game warfare [and PlayStation mentality] (...) "enabling the expansion of targeted killing" (...) "creating instability rather than security"(Cole, 2016). Could it be that the way actors view the development of smaller unmanned aircraft systems is influenced by the discussions in the media about military drones? Although the two can easily be related, they are different devices altogether- more importantly, with different purposes and different operators. But, is the discussion then only about the devices, or do we still need the drones if we already have the debate about them?[20] Also, with conflicting views and games, should there be something to win? From a market or industry perspective, there can be profit to gain. But aspects of the drone debate do not point at profit or markets at all. It is more likely to refer to domestication of drones[21] and the addition of state use, industrial possibilities, commercial uses, and even recreational use under certain conditions. "The public needs to know that agencies are getting them and what they plan on doing with them"(Trogdon, 2017), like dealing with active shooters, documenting crime scenes, monitoring crowds and assessing damage caused by natural disasters. State actors have already exerted influence on the current functions and performance about drones- there have been many attempts at handling drones, some countries more effectively than others. In the US, the Federal Aviation Administration (FAA) has exclusive sovereignty of airspace of the united states, per US Code 49 'Transportation'-federal legislation that allows the FAA to make regulatory decisions about air space and rules for border control. Although the FAA is constructively looking at (legally) framing and handling drones, the discussion about them has reached international domains: "global policymakers are currently engaged in an interactive process of competition and co-ordination"[22] and international debate is currently about regulation, not about the devices. Domestication then relates to regulatory regimes and how countries handle it, and there have been different attempts by other countries. An interesting article in the Economist (2017) mentioned that France is taking a permissive stance in drone regulation; agricultural use is primarily the focus of this permissive stance. In Britain, there are experiments with drone clusters (swarms), and there are already drone-friendly facilities and regulations. Switzerland is looking at beyond-line-of-sight operations. In the Netherlands, law enforcement organisations are looking into the possibilities of implementing RPAS technology for pubic safety purposes, while at the same time

[18] (EP 2017)

[19] (EC; European Commission 2017)

[20] (Niklas Schörnig 2013)

[21] (Boucher, Philip 2015)

[22] (TheEconomist 2017)

being aware of malicious and illegal use by civilians. Actors in Dutch public safety organisations are experiencing a learning process that has been initiated in parallel to the discussion in the media and in politics. Dutch law enforcement organisations are partially state actors, but the establishment of experimental projects points to a developmental role of actors in public safety organisations. In China, a massive blackout in the Sichuan province caused by a drone was a trigger event[23] that caused discussion in politics and led to decisions in regulation that covers application, penalty clauses, monitoring systems and civilian oversight. In summary, several state actors are looking into the possibilities of drone application, but are currently occupied with formulating laws and regulations that 'fit' the drone innovation. In summary, there are several (and somewhat conflicting) ways in which states have been coping with the drone innovation.

One can think about the next step in the innovative process. There will probably still be a discussion about the vehicles, the physical impact of devices and the possibilities and dangers they might bring. Earlier in this section, there was a discussion about two primary functions and the transition between them: from military drone-strikes, towards consumer video devices. Perhaps there is a third category: constructive learning and deployment by actors in public domains, industry and commerce (instead of recreational and military use). Examples of this deployment could include collaborating drone swarms, autonomous systems, and recently in China: a record-high sustainable flight with a solar panel drone[24] for long-term video surveillance.

Regarding the potential of drones, the sky is (quite literally) the limit. However, there are other limitations, one of which is how different states might view the development and how state actors perhaps are (actively) supporting or discouraging the innovation. For characterising the innovation and the 'game' actors play, it is interesting to look at Dutch actors in the public safety domain because of the way police and fire department are dealing with two problems: law enforcement (use by others) and development (use by themselves). However, this study aims at Dutch organisations mostly because of practical considerations- this study has relatively easy and direct access to Dutch information sources, policy documents and actors in public safety organisations. Thus, the conclusions presented in this study are about the actors in organisations in a Dutch public safety domain, not about the international discussion and the impact of drones in society. While these latter two topics are interesting, they are not the focus of this study.

[23] (John W. Kingdon 1995)

[24] (Xinhua 2017)

3.3 Projects in Dutch public safety organisations

In the Dutch public safety domain, there are currently two RPAS development projects, one by national police called *Project Onbemande Luchtvaartuigen* (POL), the other by Twente Fire Department's experimental Pilot (FDP)[25]. There is a difference between the operations and experimentation in the two projects. POL has three elements of focus:

- enforcement (*handhaving*): coordinating and rule enforcing of recreational drone use
- counter-terrorism (*contra-terreur*): making sure malicious use is prevented and disciplined
- implementation/operations (*uitvoering/operationeel*): drone use by law enforcement organisations

The first element fits in the categorisation by Finn et al. (2014) as part of the legal enforcement on the use by both commercial and recreational operators. The second element has not been listed in their report, but is important in the POL project. The third element is associated with the police's own use of drones, and conforms with the third category by these authors (law enforcement), where police units can be seen as one of the introduced government operators[26]. One of the respondents in this study explained that there has been a shift in balance on responsibilities and focus in POL. Enforcement is coordinated by the Ministry of Infrastructure and the Environment with inspection by the Human Environment and Transport Inspectorate (ILT), counter-terrorism is coordinated by the Ministry of Security and Justice with the Directorate-General Police (DGPol) as primary policy actor, but operations are partially coordinated by the Ministry of Infrastructure and the Environment. Operating procedures are covered in a local manual, which is an example for manuals in other parts of the country. However, POL's focus has shifted towards implementation and counter-terrorism rather than law enforcement. As one respondent explains: the police should not fall behind on technological performance, the police should be an exemplary and progressive organisation, and civil violations are currently more 'innocent' and less invasive, to such an extent that less effort is required of law enforcement operations.

Twente's Fire Department pilot (FDP) can be seen as a stand-alone project. Situated at a closed airport[27], a team of five pilots[28] have had relative autonomy in practicing, experimenting and operating. FDP has invested in three devices: one custom manufactured vehicle (the *Altura* RPAS) and two off-the-shelf devices (DJI M100). The difference with POL, is that FDP operates on its own, with little interference by and collaboration with local organisations, in a restricted environment and limited flying hours. FDP's investment in three RPA systems differs from POL: POL does not claim ownership of their vehicles. Their systems are test-purposive, of which the serial codes are transmissible to other RPASs. Whereas POL also focuses on law enforcement, surveillance and counter-terrorism, FDP primarily works with the firefighting unit. In POL, testing areas (Dutch: *proeftuinen*) are being launched after the summer of 2017, with fourteen existing RPAS pilots and six yet to be educated for police-specific tasks. In the testing areas, the RPAS pilots will work with self-administered training exercises

[25] these projects will hence be referred to as POL and FDP

[26] (Finn, Rachel L; Wright, David; Jacques, L; De Hert, P 2014)

[27] in April 2017, the airport was re-opened for commercial flights, after having been closed since 2007 while maintaining a military status

[28] not to be confused with 'experimental pilot'

(Dutch: *scenariovliegen*). As mentioned previously, this is already happening in FDP at Airport Twente, with a different exercise each week. The difference however, lies in the geographical area in which both projects can operate. For FDP, one day of training exercises each week, may become three days each week, since new arrangement will need to be made due to the reopening of Airport Twente for commercial flights. Since POL does not have similar available testing areas, there will be a collaboration with the Office of East Netherlands (Dutch: *Dienst Oost-Nederland*). This testing area is aimed at forensic investigation and traffic incident analysis. POL aims to work together with FDP, not in a direct sense, but to avoid overlap of work between the two organisations. Formally, the test area should conclude in January 2018. After that, there will be a consideration on budget options, purchasing own RPASs and a supporting front and back office for future operations. According to one respondent, FDP should already have finished earlier in 2017, but since their manual has yet to be inspected by the Human Environment and Transport Inspectorate (ILT), FDP is not yet finished. For the continuation of both projects, there are two considerations: budget and personnel, both causing uncertainties about the future of the projects.

4
Literature

The purpose of this chapter is to provide an overview of different concepts on the development of unmanned aerial systems, which will be accomplished by analysing different theories and views by authors in the field of public administration and technology development. Theories and concepts were collected through extensive search in electronic databases, published research articles and books that contain (references to) academic sources on this topic. Primarily, the renewed digital online library of University of Twente[29] (UT) and Google Scholar were used for digital documents and the university libraries of UT and University of Leiden were consulted for non-digital material. These databases were searched using combinations of key search terms such as drones, UAV, UAS, safety, surveillance, technology, innovation policy, regulatory design, policing, public safety and technology assessment.

4.1 Backdrop and relevance

In the development of RPAS, the two experimental projects of Dutch national police (project POL) and Twente's fire department (project FDP) have legal mandates to experiment with unmanned aerial systems. Whenever emerging technologies begin to develop, new choices and opportunities signify a process of managing and learning to manage, without compromising the legal mandates. In that regard, security (with its different meanings) is a continuous concern and also a criterion for dealing with drones, which is not specific to national police and fire brigade. However, since drones are to be used for security purposes, public safety organisations will have to address their complexity, risks and uncertainty, as well as the tension between self-monitoring (adding RPAS to the armoury) and other-monitoring (law enforcement). Complexity and uncertainty of dealing with emerging technologies can be addressed from a higher level of observation by mapping how those involved are dealing with these problems and what criteria they apply in doing so (e.g. working with existing aviation regulation)[30]. The observation is not merely relevant for public safety organisations, but is associated with a more general problem: how does society cope with new things in an existing order? In society, there are all sorts of considerations about roles and responsibilities, some of which have formed over time, others which have been enacted in (constitutional) legislation. From a state perspective, the purpose of constitutional law has been to organise society and is both a reflection of what society demands and what structures society. Furthermore, there is also the "constitution of our technological society"[31], where one tries to justify how our society deals with existing and new technologies. Since technology is pervasive, especially in modern societies, it is interesting to think on a macro level about technological change, innovation processes and embedding in society. From a public

[29] formerly divided between 'regular Library' and 'Scopus'

[30] this is something typical to innovation and new technologies, for which the question remains: can we make this happen with existing frameworks?

[31] (Arie Rip 2005)

administration perspective, understanding dynamics of technological performance and societal embedding allows innovators to be better informed in discussions about technology, its potential and (uncertain) future outcomes. These discussions revolve around roles and responsibilities, because the constitution of technology is about specifying a division of moral labour: who can do and who should do what? This is the backdrop against which the central research question has been formulated. In the next section, there will be an illustration of this backdrop and how these concepts relate to this research.

4.2 A framework for analysing technological innovation

Before introducing the way roles and responsibilities and professional discretion are part of experimentation and operation, there will first be a discussion about technological innovation as a theoretical concept in science and technology studies (STS). This will also provide an introduction to the methodology of this research, which will be further elaborated in the Methods chapter (5).

According to the Oxford Dictionary[32], innovation can be understood as introducing a new method, idea or product. Technological innovation, as Mulder (2006) adds, is the combination of not only product engineering, financial considerations and design, but also includes social demands and how this relates to stakeholders working together in the innovative process. Kroes and Meijers (2002) reflect on the concept of innovation by explaining that technological innovation is about both performance and function- a notion which they refer to as 'dual nature of artefacts'[33]. Often when a technological innovation emerges, the physical or material performance of a device comes first[34]. Based on the performance, several functionalities can be realised. In the case of RPAS, the performances are already known- or at least sufficiently available for police and fire department[35]. The discussion then is how to deal with the device[36] and what functions it actually performs[37]. It is furthermore interesting to notice that legislation must always follow innovation, since its nature implies that legislation cannot precede innovation - legislation is always lagging behind.

Following this introduction on technology development, it appears there is a platform, or playing field, in which development actors operate, collaborate and experiment. This collaboration is happening, since there are already two projects for two different organisations (as explained in the previous chapter). The actors in this socio-technical playing field focus not only on technological performance, since there are more aspects of the development (e.g. organisational challenges or issues with regulation[38]). The dynamic development of RPAS entails a difficult regulatory environment, where regulation should be 'smart', legitimate and effective[39]. There are all sorts of incentivising regulation which makes it challenging for developers and operators to start using this

[32] (Dictionary, Oxford English 2007)

[33] (Kroes, Peter; Meijers, Anthonie 2002)

[34] (Jasper Deuten; Rip, Arie; Jelsma, Jaap 1997)

[35] (WODC; Ministerie van Veiligheid en Justitie 2015)

[36] (Rijksoverheid 2016)

[37] (Dijksma 2016)

[38] (Clarke, Roger; Moses, Lyria Bennett 2014)

[39] (Browsnword, Roger, 2012) and (Heldeweg, Michiel A 2010)

emerging technology in their operations. This research project however, does not aim to formulate a regulatory framework, nor to recommend any regulatory instruments, but explores this socio-technical field of forces (*maatschappelijk krachtenveld* or 'MK') and its dynamics. In order to understand the learning process of actors and reflect on how this process could be improved, one should first characterise the playing field in which the actors can operate. The MK can take different shapes and is full of dynamic relations and patterns which are interesting to explore- this can be seen as a 'game' where actors collaborate and where insights in the process of learning how to work with drones become stabilised and gain strength.

The notion of MK is not novel- a similar concept has previously been applied in studies of technological development[40]. The empirical entrance point to identify learning stabilisation and articulation (as introduced previously in Chapter 2) for Robinson, Ruivenkamp and Rip (2007), are *modalities* in statements (also informal statements) used by actors in public and semi-public settings. This type of analysis is fairly straightforward in tracing actual and potential performance of technology. A scale has been created and used by Robinson et al. (2007) for the case of molecular machines, which was extended by Bennertz (2014) to cover actual products in use in the case of the Brazilian ethanol car[41]. Robinson et al. distinguish six types of linkages: science fiction (*it may happen*; accepted as fantasy; no action implied); visionary linkage (*it may happen*; accepted as reality based fantasy; no action implied); guiding vision (*it may happen*; action implied); expectation linkage (*it will happen*; action implied); agendas/goals (*we are going to make it happen*; action implied); and proof (*we have made it happen*; accepted as fact/reality). Bennertz adds 'preliminary use' and 'unproblematic acceptance' as two additional steps in the measurement scale. According to Bennertz (2014), 'preliminary use' is a characterisation of references -in his case regarding the ethanol car- as a "working artifact which still needed further developments"(p. 48). 'Unproblematic acceptance' "indicates references to (...) highly stable innovation, which could still be further developed to achieve even better performance results"[42]. In Appendix II, Bennertz' additional statement linkage modalities are added to the table in italics.

For societal embedding, the situation is more complex, and it is not certain if a single scale can cover the complexity (except where the usage in terms of functionality and range of users is dedicated (e.g. use by professionals in the medical sector for a particular type of treatment). Why would it then be interesting to explore both technological performance and societal embedding, and why should there be a measurement scale? Because 'societal embedding' is important for success of new technology, in addition to the performance of the new technology. For the technological performance or [T]-scale, this study can use the Robinson and Bennertz scale, which is fairly robust. For the societal embedding or [E]-scale, a reference can be made to diffusion theory[43]. In his book, Rogers (2003) illustrates a timeline of sorts, with different types of 'adopters'[44], who are participants in the innovation process and who carry the (technological) innovations over various disciplines. Diffusion, as he explains, is "the process by which (1) an innovation (2) is communicated through certain channels (3) over time

[40] (Rip, Arie 1992)

[41] An overview of the scale and its items can be found in Appendix II

[42] (Bennertz, Rafael 2014, p.48)

[43] (Rogers, Everett M 2003)

[44] i.e. innovators, early adopters, early majority, late majority and laggards (Rogers, Everett M 2003)

(4) among the members of a social system"(p. 11). What it still misses, is a consideration of what happens at the societal level, in various spaces/arenas. The concept of 'societal embedding' (a process and its outcomes) draws attention to cultural uptake in concrete practices. Taking the work of Rip (1992) as a starting point for the construction of a societal embedment [E]-scale, one could image the inclusion of both uptake in user practices, and societal embedding, in parallel as it were. In the literature, there is an interesting attempt to further characterise (or articulate) societal embedding. According to Deuten et al. (1997), there are three dimensions which characterise the notion of [E]: (1) integration (requiring new practices and repertoires), (2) admissibility (according to rules and standards) and (3) acceptance (no overly large societal concern, "sufficient articulation of pros and cons"(p. 132) and the actual use of the product). These three elements may be correlated and part of a single scale. However, if a scale was to be constructed for [E], it should have two dimensions- one about practices in which technology is articulated[45] and domesticated (micro-level) and the other about regulatory decisions, public debate and concerns of third parties (macro-level). Both dimensions can capture the entire uptake and a forked scale allows for the two dimensions to develop in parallel. A forked scale begins with the assumption that one scale is possible before actual introduction, after which two parallel scales capture the complexity of societal embedding. Granted, there is no clean cut in the process before and after the introduction, and there will be anticipation on regulation before the introduction of the technology (which is essential to responsible development[46]). Based on the work by Deuten, Jelsma and Rip[47], a forked scale was created using the following 'scores', which are more describing stages of the story of societal embedding. First, there are visions about technological possibilities and indications how to realise them. Then, actors formulate comments on overcoming barriers for the realisation of the formed vision. Next, actors start preparations for introducing the technology. They evaluate first experiences with the introduction; this is where the forked scale starts. On one side, the new technology has to fit in with existing practices/cultures. Then, there can be a modification of existing practices/cultures to profit from the new possibilities offered by the new technology. Actors may encounter difficulties and challenges and they can address them. In the final step, actors are able to solve tensions and challenges and can cause structural changes in existing practices and culture. On the other side, there may be requests for precautionary regulation; there are early users and there is some publicity around the use. Next, third parties start responding and some of their concerns are voiced. The final step in an effective uptake of the new technology, actors realise the technology is 'here to stay'. An overview of the items in this forked scale can be found in Appendix II.

In summary, two parallel paths can be useful for determining the uptake of a technology in society. Because the process of uptake and embedding is complex, there should (to the very least) be a distinction between macro-level and micro-level. Moreover, the distinction between a macro and micro dimension is interesting since this dichotomy is also relevant for the two types of organisations in this study (i.e. public/state actors and developmental/project actors).

---

[45] from a sociological perspective, referring to the manner in which cultural forms and practices are appropriated by social groups

[46] as illustrated in work of (René von Schomberg 2015) and (Roger Brownsword; Oxford Internet Institute 2012)

[47] I am grateful to Rip (personal communication, January 31, 2017) for offering a first version of this [E]-scale, which was based on his earlier collaboration with Deuten and Jelsma (1997)

4.3 Division of moral labour

Whenever actors engage in the innovation of emerging technologies, they will assume different roles and determine responsibilities. There are a number of new technologies, not specifically drones, such as nanotechnology and synthetic biology, where issues of uncertainty demand a response from society. Part of this response is determining different roles and responsibilities. One example of role division in society, unrelated to technological development, is the responsibility of parents towards their children. Whenever parents do not, or are unable to take care of their children -in the broadest sense- other role actors will have to take responsibility.

For (technological) innovation, the notion of emerging and changing division of moral labour is captured in the so-called Collingridge dilemma. As "technology is developed first, and somewhat at a distance from society"(Rip, 2017, p. 114), there is little knowledge and a lot of uncertainty about the impacts and embedding in society, so unclarity how to assess the technology and what to do about it. By the time there is more clarity, investments will have already been made, which locks in certain parts of the development (i.e. sunk investments). Thus, control by societal actors is often too late. Historically, government ministries have different responsibilities, with Ministries of Economic Affairs, or Trade and Industry promoting new technology and innovation, while Ministries of Social Affair and Environmental Affairs -often at a later stage- have to take care of unintended effects of uptake and embedding in society. A new concept, recently introduced by the European Commission, is the need for -and then challenge of- responsible research and innovation (RRI). As Rip (2014) reports it, RRI is about escaping the Collingridge dilemma by appealing to the responsibility of innovators to take initiative and to involve others early-on, instead of awaiting regulatory decisions. This is a further step in the tradition of technology assessment by governments which emerged in the 1970s.

One way to mitigate the dilemma, specific to the case of RPAS in public safety organisations, might be early experimentation with technology and its embedding in society, and making sure the learning is documented (for example in an operating procedures manual). By devoting oneself to write a manual, one is compelled to gather experience and to think about division of, and sharing responsibilities. This is exactly what is happening with POL and FDP: both the Dutch national police unit[48] and Twente's fire department are thinking about deploying RPAS within their own organisations. Their strategy includes technology-specific choices (whether research and design is part of the development, or to go for buying off-the shelf technology), organisational choices (in what way can using this technology achieve organisational goals and mandates) and division of responsibilities (who will be in charge of training which pilots). Division of moral labour is a general aspect of how societies organise themselves. It can, however, be contested- sometimes because there are different interests or because of the uncertainties that surround a new technology. For drones, there appears to be little contestation, except perhaps for privacy issues- drones are mostly seen as new toys to play with.

[48] Dutch: *landelijke eenheid*

4.4 Professional discretion

When public safety organisations start using UAVs, at first experimentally, they will refer to their mandate of assuring safety and security as a guiding principle. One effect is the need felt by the public safety organisations to establish comprehensive operating procedures manuals. There is an ambivalence, however, about the advantages of providing professionals with clear guidelines on the one hand (i.e. when and how to operate unmanned aircraft systems), and on the other hand allowing them room to operate according to circumstances, and on the basis of their professional skills and experiences. One argument for the latter is that manuals can never be fully comprehensive. If they were, their use would become inconvenient. Furthermore, the process of learning is currently still going on, and manuals should in general not only be user-friendly, but also dynamic. In other words, practitioners (i.e. professionals) will have a responsibility for implementation of guidelines in practice, with some professional discretion.

There are similarities with so-called principal-agent interactions[49]. Instead of a customer who concludes a contract with an agent, the mandate of the public safety organisations can be seen as the equivalent of a contract which can be reinforced and monitored top-down by state actors. In the principal-agent analysis, the agent is assumed to be more knowledgeable about his tasks than the agent, who in turn is responsible for delegating the task to the agent. However, if the agent has his own interest, he may *shirk* (i.e. avoid responsibility). Thus, there is a need for the agent to monitor what is happening (which also creates additional costs for the agent)[50]. From a public administration perspective, this is the issue of *professional discretion.* Discretion, as Evans (2016, p. 2) explains, concerns the extent of freedom a professional worker has, including all factors that contribute to that amount of freedom. Evans illustrates the necessity and inevitability of professional discretion in welfare bureaucracies, such as public service organisations, a category in which public safety organisations fit. According to Evans, public safety organisations have limited resources and conflicting policy goals, where discretion "arises from the need to turn broad goals into practical policy"(p. 3) - this clearly applies to the practical execution of implementing broad operational procedures manuals. Freedom to operate may also lead to new findings, which can then be added to the operating procedures. Evans refers to two of Lipsky's[51] claims relevant to the case of RPAS. First, professionals can identify and recognise the need for both flexibility and adaptation of broader defined goals in certain aspects of their work. Second, there is a desire of (policy) managers to contain discretion while *street level bureaucrats*[52] have their local self-interest in mind and may respond by *shirking.*

[49] as illustrated by (Jensen, Michael C; Meckling, William H 1976) and (Holmstrom, Bengt; Milgrom, Paul 1991)

[50] cf. how Van der Meulen (1998) has further articulated principal-agent analysis in the domain of science policy

[51] (Lipsky, Michael 2010)

[52] (Evans, Tony 2016)

4.5 Games in technological innovation

As was clear in the previous two sections about division of moral labour and professional discretion, there are elements of game playing involved, which add to the perspective on the overall process as a game of drones. The previous sections identified contestation games and principal-agent games as structured patterns that can be traced back to public administration literature. With technological innovation and societal uptake of technology, there are further games. A well-known example is the prisoner's dilemma[53], where lack of coordination leads to sub-optimal outcomes. Historically, for technological innovation, one could refer to the arms race during the cold war[54]. Another example, although less extensively described and analysed, are 'waiting games'. Waiting games can occur when demand is not articulated and developers are therefore unwilling to invest in dedicated but risky product development. Another kind of waiting game occurs in nano-enabled food packaging where companies are reluctant to invest in food innovation until there is regulation that provides some assurance to costumers, while regulator cannot regulate if there is no product in the market[55]. Government decisions will always incentivise or discourage actors in the process of innovation and uptake in society. In the case of drones, one can expect waiting strategies from the side of RPAS regulators as well as regulatees[56] (i.e. developers). Actually, developers are faced with a dilemma: they can either develop and hope that the regulator allows new drone systems with the risk of being banned, or they can wait to develop until the regulator has made rules, with the risk that other developers go on and create a head start for themselves. The regulators have their own dilemma: being pro-active but careful (i.e. precautionary), with the risk that they will dis-incentive development which may eventually be desirable; or wait with regulation and risk that development occurs through market forces and individual choices, which turn out to have suboptimal outcomes that by then cannot be reversed[57].

Of course, governments have a variety of options- it is not a matter of regulating versus not regulating. A common way for characterising policy instruments can be formulated as carrots, sticks or sermons[58] (i.e. rewards, punishments or persuasion). In the case of drones, there are government documents[59] recognising the promise of drones (*sermons*) and reference to existing regulation prohibiting or constraining certain uses (a version of *sticks*). Whereas promising functionalities of a technology may lead to *carrot*-type policies, issues of privacy may lead to *stick*-type policies.

[53] (Tucker, Albert W 1980)

[54] an example of conflicting opinions in the political domain, as previously illustrated in Chapter 3

[55] Parandian et al. (2012) develop scenarios of ways of breaking through the waiting games, for example when regulators become pro-active and formulate intentions for concrete regulation of nano-enabled food packaging

[56] those who are regulated or subject to regulation, previously introduced by (Brownsword and Somsen, 2009)

[57] I am grateful to prof.dr. Barend van der Meulen for suggesting this way of looking at technical innovation and regulation

[58] (Bemelmans-Videc, Marie-Louise; Rist, Ray C; Vedung, Evert Oskar 2011) [among others]

[59] (SKIA, 2017) ; (Dijksma 2016) ; (Politie, 2015) ; (Koper et al., 2015)

5
Methods

To explore the dynamics of RPAS in the strategic game (of drones), this study will first characterise the 'maatschappelijk krachtenveld' (MK), including which actors are in this playing field, the relation between these actors, the current operations and experiments and the future of the development. After describing the MK, this study looked for cross-cutting elements or patterns in this MK- this second part of the study is more analytical. As introduced in the previous chapter, this research's focus is on the elements for technological performance by Robinson et al. (2007) [T]-scale and the embedding in society [E]-scale. The choice for statement linkage modalities is used, since the movement of promises to functions of a technology is dependent on changes in modalities that express its existence (Bennertz 2014, p. 47).

A series of interviews has been conducted with actors that represent their organisation or organisational project for RPAS development. The approach to this research included finding representatives that were able to reflect on the policy changes, regulatory strategy and societal implementation. These actors are not able to reflect on in-depth experiences with the technology (e.g. training exercises). A second actor group was approached to reflect on direct experiences with the technology. In the orientation phase of this study, several relevant actors, developers and policy-makers were approached to contribute to this research by pointing out the most relevant respondents for this study. The interviews were conducted in early 2017. Respondents were individually contacted for an interview, preferably located at their own organisation. The interviews can be characterised as expert interviews or 'role-player interviews', since there is an emphasis on their roles within the organisation. These role-players have their own expertise based on their experience, but may also have obtained this experience outside of these projects (e.g. previous education or other projects). A format for interview questions has been created based on [T] and [E], as well as themes that were important in UAV discussions (see Ch. 3.1). In these interviews, the selected themes were discussed with the respondents and there was room for further in-depth questions and elaboration of the answers. The chosen structure (i.e. semi-structured interviews) allows for a more in-depth discussion and enables the researcher to ask additional questions.

Following the attendance of a conference on safety policy in the Netherlands, possible respondents were contacted via telephone. An informal meeting with two policy employees working in the Ministry of Security and Justice in The Hague was followed by the first recorded interview. Both policy employees are working for the Directorate-General of the national police and were able to discuss the current development of drones at the Ministry and the policy goals for national police. Shortly after having interviewed these two Ministry representatives, there were interviews with both the project leader of the experimental RPAS projects- the first being with POL's project leader at Driebergen-Zeist, where the national police unit is located. The respondent spoke about several aspects of the development and the application of drones in POL. The third recorded interview was then conducted with the project leader of the Twente Fire Department's experimental pilot, which was located at the RPAS test centre at Twente's airport. The next interviews were conducted with five other representatives of both POL and FDP.

Finally, to gain additional insights in the future of RPAS in policing, there was another interview with the project leader of POL[60]. The audio of the seven interviews has been captured using a mobile recording device. Each interview has been transcribed by hand in Dutch, by using elements based on traditional conversation analysis. This includes the transcription of vocal breaks, fillers and blank words, the reconstruction of half-uttered words, non-verbal communication and minor non-verbal events during the conversation. The transcriptions were then analysed to track modal statements and to find recurring patterns throughout the data. To protect the privacy of the respondents, the full transcriptions have not been added to this thesis. However, several quotes will be used in this study's results, with verbal consent of the respondents, while avoiding mentioning their names or any sensitive and confidential information.

[60] In Appendix II, Table II lists an overview of the respondents and their transcription reference

6
Findings

In this chapter, the results of this research will be used to address the different sub-questions for this study. First, there will be an overview of the respondents that were approached in this study and the actors mentioned by these respondents. Second, the way these actors view the development of RPAS, will be discussed. Their relation and the dynamic interactions between them will also be illustrated. Third, there will be an overview of the way experimental projects are constructed, monitored and evaluated. Fourth, the view on development will be explored based on two previously introduced elements of technology assessment- technological performance and societal embedding. Fifth, there will be an overview of recurring patterns occurring in the MK. Finally, there will be a consideration about the role of the state in the MK and in the process of technological innovation. The final part will also mention recommendations about using policy instruments to incentivise, discourage and inform actors to improve learning in the experimental projects.

6.1 Actors in the public safety domain

In this study, eight expert interviews were conducted, with a total of nine respondents[61]. Two actor groups can be distinguished: state actors, and development actors (i.e. project actors[62]). The Ministries of Security and Justice, Infrastructure and the Environment, and Defence can be characterised as *state actors*[63]. The findings of this study show that representatives and policy employees in these Ministries think about the strategy of RPAS development on a national scale, about the possibilities the technological innovation brings; they collaborate with organisations that implement the strategy and they can provide additional support (i.e. budget) for projects. Whereas the Ministry of Security and Justice focuses on the collaboration with Directorate-General police and on practical implications in law enforcement (i.e. strategies for coping with safety challenges), the Ministry of Infrastructure and the Environment works together with the Human Environment and Transport Inspectorate (ILT) on the operational side of the development (i.e. legal exemptions for exercises). Focus on law enforcement and operations can also be found in the police and fire department: the former relates to the use by others, and the latter by the use of the organisations themselves[64].

Previously, this study assumed that the experimental projects of national police and fire department were similar. Although their aim is comparable (i.e. developing RPAS for public safety purposes in a broad sense), the approach is different to some extent. These two organisations can be characterised as two independent semi-public safety organisations or *developing actors*. Developing in this sense relates to the uptake of the technological

[61] In Table II (Appendix II), an overview of the different expert interviews is shown

[62] the phrases 'development actors' and 'project actors' refer to the same group of actors and are interchangeable in this study

[63] the phrases 'state actors' and 'non-state actors' have previously been used in policy documents (SKIA, 2017, p. 25)

[64] in Dutch, the two phrases are translated to *handhaving en contra-terreur* and *uitvoering en operationeel*

innovation in a separate part of the organisation, not in the entire organisation. The difference between the two becomes apparent when looking at the way the projects are organised and executed. POL is essentially a project organisation itself, with a project leader, a deputy project leader, an operational coordinator, specialised employees (i.e. flight instructors) and pilots. The pilots were not approached in this study, since it was difficult to visit one of the training locations. FDP differs from POL because of the way the experimental pilot is currently part of the regional unit (i.e. Twente's fire department) and the choice to purchase and train with vehicles of their own. The instructor and four pilots operate within the possibilities and limits of the organisation, but are located separately- they have their own training location. POL has two training locations, which are distributed through the Ministry of Defence. Both experimental projects have received requests for real-life operations in addition to the training exercises. Beside the actors organisations in which the respondents are working, the actors mentioned the Ministry of Defence, the Human Environment and Transport Inspectorate and the Netherlands Aerospace Institute (NLR), which provides basic training for the pilots. Due to the relative brief time period in which this study was performed, these three organisations were not approached.

The purpose of this section was to illustrate the different actor groups and to provide an answer to the sub-question: *which actor groups can be distinguished in the innovation of RPAS for public safety purposes?* Previously, this study assumed there were policy-making actors and operational actors. The three above mentioned Ministries can be characterised as *state actors* because of their focus on policy strategy and top-down collaboration with operational actors in law enforcement. There is however a difference in focus: law enforcement for Security and Justice, and operations for Infrastructure and the Environment. It appears that the previously assumed similar experimental pilots (i.e. POL and FDP) differ in both organisational structure, size and operational focus and are *development actors*. FDP is part of the local fire department in Twente and has autonomy in both RPAS exercises and training location. POL is a separate project organisation, but the representatives are located in Schiphol-Oost (i.e. aviation police base) and in Driebergen-Zeist (i.e. national police unit). POL does not have complete autonomy in training exercises, location, and materials, since these are provided by the Ministries. In short: in the development of RPAS, there is a difference between *state actors* and *development actors*. The collected data show relevant information about which organisations are part of these two actor groups. This information about actor groups is a first attempt to illustrate the actors in the *maatschappelijk krachtenveld* (MK). Next, it is important to realise the potential of these actors in the MK to further develop RPA systems. This will be done by looking at the way these actor groups view the development of RPAS and what the dynamic relations between actor groups entail.

6.2 Actor perspective on RPAS development

From a *state actor* perspective, the RPAS development causes two main challenges: issues regarding societal safety and tensions related to privacy. The discussion of privacy and safety issues may retard the implementation of RPAS, since more deliberation takes more time. Although these challenges are an important factor for their view on the development, state actors see RPAS innovation as an *unstoppable train*: the technology is already prevalent and also quite pervasive- they think it will influence our daily lives in the near future. Respondents in the Ministry of Security and Justice mentioned several opportunities of the technology in law enforcement. This study, however, did not collect information on the view of state actors in operational-oriented policy organisations (e.g. Human and Transport Inspectorate). It is therefore difficult to speculate on what view state actors have, other than what the approached actors mentioned about them. *Development actors* in both POL and FDP view unmanned aerial systems as an extension of their current armoury. In both projects, drones are not viewed as mere stand-alone devices. Respondents also do not show a particular (un)favourable position towards the devices itself. Instead, the payload carried by the aerial vehicle is considered more important (e.g. a 360 degree or infra-red camera). The way drones are treated in POL contrasts media attention, which tends to shift towards uncertainty of the performance of the vehicle[65], not its functionalities. The way POL treats the combination of device and payload is visible in the strategy POL has taken in purchasing own vehicles. Since 2015, POL instructors and pilots have been flying with loan units, owned by the Ministry of Defence. Twente's fire department, however, has already purchased three unmanned vehicles, two of which are off-the -shelf models, and one of which has been customised to the preferences of the department.

In terms of possibilities of performing safety tasks, respondents have mentioned several opportunities the development of RPAS may bring, such as improving efficiency of surveillance or an alternative to static camera systems. The innovative character of RPAS can also be linked not only factual improvement (i.e. armoury expansion), but also to improvements on an organisational level. In practice, as the respondents mention, technological innovation -because of the promises it entails- also causes innovation within the organisation. Respondents show that their organisation will need to adapt to new technological systems in terms of performing organisational tasks. Dutch national police have framed three domains in which they put RPAS development, (1) deployment of RPAS for police operations, (2) enforcing regulation (e.g. violations with recreational drones), (3) counter-malicious measures (detection, identification, interception, intervention). The third area differs from violations with recreational drones in terms of scale- the measures refer to large-scale events or undesirable locations, whereas enforcing regulation for recreational drones concerns deployment by individuals and individual cases.

Beside opportunities framed in Chapter 3 and the opportunities mentioned by the respondents, there are some issues, dilemmas and challenges associated with unmanned aerial systems. With regard to technological development and impact in the organisations, Dutch police and fire department units cannot afford to operate with complete autonomy. They will have to look for financial possibilities and make careful considerations. In that sense, they are part of the MK, where they are obliged to make cost-effective decisions, while being in the process

[65] (Clarke, Roger 2014)

of learning about working with drones. Other challenges these organisations have mentioned, are certification of pilots and the RPA systems, getting the right personnel, education of new pilots, and choosing organisations that will provide the necessary training in the future.

A final observation on how actors view the development of RPAS relates to how respondents formulate future deployment strategies. For example, state actors are not proactive in their deployment strategies, since they await legislative and executive development and have put their trust in operational actors regarding reliable and responsible RPAS development. Development actors in POL are reactive- they are confronted with other actor groups using drones (i.e. outside of the police organisation). At the same time, they are forced to think about optimal scenarios for their own deployment, but they are not yet pursuing these operations. Development actors in FDP are relatively more proactive: only the local unit in Twente is currently conducting experiments and constructing an operational procedures manual. This unit is also already introducing RPAS in existing fire department procedures, making them the most proactive actor group in this study. The future implementation of RPAS, especially considering the future use outside the framework of the projects, is therefore to some extent limited by the non-proactive actions of the organisations.

The purpose of this section was to answer to the sub-question: *how are actors viewing the emergence of drones and what implications do drones have in the public safety domain?* The approached public safety organisations in this study differ in their proactive strategy and consideration of deployment of RPAS in the future. The results show that state actors contribute to the learning process by leaving practical issues to the project actors and by deliberating with other state actors about privacy and safety issues. State actors are also reactive because they have put their trust in the project organisations. Actors in POL view unmanned aerial systems as addition to their armoury, instead of separate, individual technological vehicles that need their own development. This enables the actors to focus on working with what is available and how they can use available devices for their experiments and operations. Either view contributes to knowledge about how to work with drones, but both actor groups have a different impact on future implementation.

6.3 POL and FDP: project methodology

The two experimental projects for RPAS development have started in 2015 being part of the existing organisation, with newly employed project leaders and project executives for both organisations. As respondent C explained, POL is a stand-alone project organisation with one steering committee and five task force units. Information flows from the project executives, to the steering committee, to the five units. However, experience shows that it is the other way around. In addition to this information transfer, there are two separate units: a product-service center which is responsible for purchasing equipment and a team of policy employees. FDP's organisation is relatively smaller: five licensed pilots, including two instructors.

In POL, there are test areas (Dutch: *proeftuinen*) which provide space to test vehicles and to experiment with flight scenarios (e.g. special manoeuvres and certain weather conditions). FDP has the same type of experimental space, but this is limited to one specific weekday and to one specific location. POL has the advantage of collaborative spaces with the Ministry of Defence, which also provides loan vehicles for POL's operations (whereas FDP has purchased three of their own.) For each individual *proeftuin* operation, there is a requirement of obtaining an legal exemption to experiment in a controlled perimeter. In addition to these controlled areas for experimentation, POL has received several official requests for RPAS deployment in real-life situations. POL tries to draw less attention in the media about these operations, though. FDP however, uses media exposure to show possibilities of the technology to their colleagues in the firefighting unit. According to respondent C, operations in POL include, but are not limited to: traffic accident analysis; forensic detection; birds of prey; and stealth operations (arrest teams and service specialist interventions).

The obtained knowledge in these experiments is not merely about exploring functionalities, but also about gaining insights on secondary knowledge such as meteorology or building mapping. Training results are collected by the instructors and are included in future practical operations. There is however, no clear methodology for POL's operations, since each individual (experimental) operation requires its own legal exemption. There is no proactivity yet in the operations, nor any desire to do so. Experiences are shared between pilots in weekly meetings. Merely the experiences that are operationally relevant are recorded- other experiences remain within the meetings. Both POL and FDP are individually working on an operation procedures manual. This manual includes several elements (e.g. location, safe environment, setting up a perimeter, controlling situations, visibility, flight procedures, and roles of different pilots, instructors, captain and payload operators). The way experience is shared, could be arranged more effectively. One example the respondents mentioned, is how helicopter pilots are using a log system which is available to every crew member. Although respondent C showed no particular favour to a log system for drones, an online service for information transfer might be beneficial for sharing knowledge between pilots in local units in the future.

Respondents in POL and FDP were also asked if and how projects were monitored. The flight instructors in both projects are responsible for operational oversight, but the respondents did not show any monitoring outside of the project. As stated before, the projects are autonomous in the sense that they can be regulated according to the standards and requirements by the project employees- they together shape the focus of the project. The results show no direct oversight by state actors. The same is true for project evaluation- currently, there is some degree

of evaluation regarding the recorded experiences with RPA systems and flight procedures. However, this knowledge remains within the project and the evaluation itself is not recorded or communicated to state organisations. For large projects such as POL and FDP, one could expect state oversight because of the importance these state actors see the development- as an unstoppable train that requires a responsible development. Moreover, one can assume that the project representatives feel this responsibility to some degree- this can however not be derived from the collected data. It is therefore difficult to say whether this type of knowledge transfer can be improved.

In this section, the following question was addressed: *how are experimental RPAS projects constructed, monitored and evaluated?* POL and FDP are two independent experimental projects- the first being a project organisation related to the national unit, the latter as part of the local fire department in Twente. Whereas FDP experiments are conducted in a dedicated RPAS test area at Airport Twente, POL can use two test locations provided by state actors. As for monitoring and evaluation, information stays within the projects and there is some degree of responsibility of sharing this knowledge with other project representatives- however, the chosen approach in this study could not find information on whether state actors are currently monitoring the experimental projects. If this is the case and the collected data do represent the actual projects, it could mean two things. Perhaps the state actors are unaware of the project details, which could cause some distress for state actors, since the autonomy given by the actors may cause a principal-agent issue. Another explanation is that there is currently not enough project data available for state actors to form an opinion on the current project structure. Respondents have mentioned that the creation of operational procedure manuals might play a role in the state actors' view on the progress. The process of interviewing the respondents in this study may be insufficient for providing a complete answer to the sub-question in this section. It may be that there is indeed some form of state oversight, but that the respondents chose not to talk about this oversight in the interviews. It could also be that the way the interviews were constructed (i.e. focusing on challenges and dilemmas within the projects as experienced by the individual respondents).

6.4 Technological performance [T] and societal Embedding [E]

In the preparatory construction of the interviews, this study aimed at exploring the development of drone innovation according two two themes derived from STS: technological performance [T][66] and uptake or societal embedding [E][67]. Actors have responded with little information about these two elements. Before trying to explain the implications of this absence of interest by the actors, I will first illustrate the current elements which are somehow related to [T] and [E] by presenting the results from the data.

FDP has purchased three unmanned aerial devices, two of which have been customised to the preferences of the fire department- though only with available parts of the technology (e.g. wings, chassis, payload type). POL has not invested in any devices of their own yet. Both projects do not have a research and development (R&D) department and both are not directly involved in the process of developing future technologies. In the interviews, the respondents were asked if, in the future, there would be an interest to be involved in any development of [T] themselves, or if they have requirements for developers for future [T]. For [T], it seems that, in contrast with other domains of technological innovation, RPAS was mentioned as being an 'accepted practice' or *unstoppable train* ("*het is er, het komt er*"- respondent A ; "*omdat we ingehaald worden door de praktijk*"- respondent C ; "*ik denk niet dat het terug te draaien is*"- respondent D). Following Robinson's scale, the statements made by the respondents can be considered 'Expectation linkage', since both project are already working with this technology. RPAS [T] as such, can be seen as *off-the-shelf*. However, in the interviews, there were some inquiries about the different forms of RPAS and its functions. It appears the RPA system (the vehicle itself) differs both from a legal perspective as from an operational standpoint, from the payload (e.g. a camera). In the results, three observations are interesting to mention.

First, the devices themselves are currently not custom-made for POL and FDP. FDP used to have a custom-made device, but reported that the technical support and availability of information for this vehicle is limited. Because of this, the two additional purchased machines were manufactured by DJI, a renowned manufacturer for both commercial and professional UAVs. In POL, the machines were also not custom-made. Second, respondents did not report technical requirements for the different parts on the vehicle (e.g. wings, chassis). Instead, they work with "what is available", since this is "more cost-effective" and "takes less time and effort", according to the respondents. This is interesting, since national police and fire department, which, as respondent E states, 'should not fall behind' and "*het beste jongetje van de klas [moeten] zijn*" (should be top of the class). One could assume this implies looking for technological opportunities that exceed the available and *off-the-shelf* RPA systems and their payloads, which does not seem to be the case for both projects. Third, when asked about the future possible applications of RPA and payload systems, respondents D, G and H stated that for the fire department, payload systems for fire extinguishing are currently not pursued in FDP, even when having admitted that such systems could potentially save human lives, or at least contribute to the efficiency of such operations. In POL, training procedures involve pushing boundaries and the use of other devices (respondent C: "*we zijn de grenzen aan het verzetten* (...) *gebruik maken van de Raven en Scan Eagle van Defensie en een helikopter gebruikt van de*

[66] i.e. actual and potential performance of a technology, working configurations, (device, product, system), inspired by Robinson's (2007) and Bennertz' (2014) approach to technology assessment

[67] i.e. success of the new technology, promises, uptake and uses, inspired by Deuten et al. (1997)

Luchtvaart[politie]"). These devices, however, are off-the-shelf systems and have been put available by other organisations that are already involved in the construction of POL. In summary, the pursuit of technological performance [T] does not exceed off-the-shelf systems and what is currently available. Respondents have mentioned that the focus of the projects is to create workarounds within regulation and their organisations and that [T] is secondary in their approach. However, respondents have to some degree mentioned an interest in future possibilities of the [T] (e.g. extinguishing fire, gas detection, on-board radio antenna). All of these possibilities are not yet pursued by the respondents. This absence of interest is not the same for different RPAS-developing organisations- respondents have mentioned research and development in the Netherlands Aerospace Centre (NLR)[68].

The results show that respondents are currently not concerned with uptake of RPAS in society. Aspects of the RPAS discussion and associated challenges stay within their own projects and within their organisations. Some elements of societal embedding, as followed by Finn's findings (i.e. privacy and data protection), were mentioned by the researcher as a 'stimulant' in the discussion in the interviews, but were considered less important than organisational challenges. Although it seems these elements are not important, the respondents clearly mentioned that the issues related to these elements of [E] were 'not their responsibility' (respondent C), since other organisations are indicated for solving these issues. One example that was mentioned involved the ownership of data collected through an RPAS payload camera (i.e. video footage), which is legally not owned by the police or fire department, but by the client or instructing party. One aspect related to technological embedding is uptake within the organisation- the 'shift in culture' in the organisations. This relates to how employees are informed about the new technology and how they can implement its use in their daily operations, and how currency employed helicopter pilots view RPAS development. As respondent I explains, existing pilots are not afraid of losing their jobs, but, as respondent F points out, employees that have been part of the organisation for a long time may see RPAS as a threat to their own operations. However, almost all respondents agree that drones are an addition to the operational arsenal instead of replacing current video intelligence systems.

In this section, the following sub-question was addressed: *to what extent are technological performance and societal embedding relevant for public safety organisations?* The results show that respondents have not shown interest in technological performance of RPAS, other than what is available off-the-shelf. In earlier work by Robinson and Bennertz, results on [T] and [E] were more prominent. Given the small number of respondents and the moment in time the interviews have been conducted, only a limited statement can be made about this sub-question. Pursuing technological performance will become important for actors if future operations require knowledge how to work with newer systems. Also, operations will in the future have an impact on society and citizens. All experimentation in the projects will to some degree contribute to how people will deal with a newer technology. Thus, it would be beneficial to the learning process of the actors to include considerations about societal impact and also technological performance while projects are still advancing. When projects are finalised, it will be too late for actors to experiment in independent and relatively safe experimental spaces. Finally, once additional real-life operations show a need for specific improvements of technological performance (i.e. extinguishing fires, covert operations), actors might become more interested in influencing the future performance.

[68] see also: (NLR 2017)

6.5 Recurring patterns - innovation in the public sector

When analysing the collected and co-constructed data, the characterisation of the dynamic drone development and the *maatschappelijk krachtenveld* can be expanded by looking for recurring patterns. These patterns include observations that emerge in the collected data, but which are not traceable in all of the individual interviews. When overlooking the interviews, it is interesting to notice that all respondents mention these patterns somehow, some individuals more frequently than others. These patterns and organisational challenges are apparently issues that have occurred in the MK, which are therefore worth the effort of mentioning here. This analytical step in presenting the results of the study provides a more in-depth look at recurring elements in technological innovation and may not be limited to the development of RPAS. In this analytical step, these patterns will be illustrated based on modal statements used in the individual interviews, which have been analysed by the researcher. In total, there are three patterns which will be discussed.

1. Roles, responsibilities and division of moral labour
2. Room to play - professional discretion vs. working by-the-book
3. Requirements for future technological development

Each pattern will be portrayed using examples as presented by respondents and by using modal statements from individual interviews.

6.5.1 Roles and responsibilities

As introduced in the Theory chapter of this study and following studies on division of moral labour, the Collingridge dilemma portrays that for a technology to prosper, two aspects should be considered. First, there should be a careful and timely consideration of (technological) opportunities and an early control (or initiative) by appealing to the responsibility of innovators and early adopters to experiment with new technology. Secondly, there should be a process of gaining insights and involving other parties early-on, before regulatory decisions will have been made. As recurring pattern in the data, respondents seem to reflect on this notion of intervention by having designed experimental projects outside of societal (and regulatory) interference.

Looking at the way (semi-)public bodies are part of solving this dilemma, there are interesting aspects of division of moral labour and the way roles are divided, and how responsibilities are delegated (and self-imposed). Respondents have mentioned different roles in procedural operations manuals[69]. Division of moral labour appeals to more than just roles in experimental project, since it is about roles in the complete development. It refers to the way actors treat each other and work with each other. One important element as mentioned by the respondents, is trust between actor groups. There is also a reference of choosing cost-effective strategies and a more efficient approach to handling technological innovation. One important aspect for the execution of the experimental projects, is the way representatives in POL talk about the responsibility delegated by public bodies and the trust they have been given for executing the project (respondent C: '*het ministerie (…) heeft al zo veel vertrouwen in ons'*). POL professionals have the opportunity to delegate roles within the project, but this

[69] these manuals will be further discussed in the pattern 'Room to Play'

opportunity has in turn been delegated to the POL professionals by the Ministry of Infrastructure and the Environment and the Ministry of Safety and Security ('*wij zijn daar niet verantwoordelijk voor'* ; '*wij zijn er alleen voor* (...)'). Respondents exemplified this responsibility by explaining how an instructor is educated to play the role of unmanned aerial flight captain (respondent C: '*je moet aan kunnen tonen* (...) *op het moment dat je dat allemaal ondervonden hebt* (...) *dan pas ben je bevoegd om gezagvoerder te worden*').

Another element in the execution of the project and the way roles and responsibilities are a recurring theme, is visible in the way respondents talk about the continuity of the projects. Respondents E and C mentioned the future establishment of a flight school for pilot education and a front-back office at Schiphol airport for flight requests (e.g. to avoid interference with current helicopter flights). Both respondents E and C have talked about the viability of these future organisations and who is responsible. An interesting thing to see is that respondents currently are focused on obtaining additional funds and personnel, instead of thinking about the future of the experimental projects (respondent D: '*het project loopt nu tot januari 2018* (...) *dan is het aan anderen die keuze te maken!*'). The continuation of the project is also characterised by the deployment of RPAS in local units. Respondents believe that eventually, having a pilot's license will be 'just as normal' as having a driver's license. When the six available helicopters at Schiphol airport will only be used for 'more dynamic operations' (Res. C) and RPAS for 'local and static operations', there is a responsibility for representatives of the renewed organisations (i.e. flight school) and the instructors who work for local units.

When comparing this to the danger according to the Collingridge dilemma, the existence of these projects and the considerations of future deployment are still too far away from society, and then come too late in the development process. The results show that POL is not aware of hazards beside the estimation of their own deployment, which remains within a controlled area. There seems to be some form of early control (i.e. being at the forefront of RPAS development) which finds its uptake within public safety organisations, which also have the responsibility to think about repercussions of the technology in other domains than their own deployment (i.e. law enforcement and counter-terrorism operations). There is an opportunity for these organisations to apply both new rules for law enforcement and to deploy RPAS for own operations, parallel to each other. In a sense (as reflection on the previous section on societal embedding), there are some considerations about societal embedding and uptake. It could also be that there is some form of organisational pressure due to delegation of tasks by the previously mentioned ministries. This is implied by the autonomous character of the two projects and the relative small staff working in these projects. However, it does not appear that there is any pressure for actors in this project ("*ik maak het voor mijzelf als project gemakkelijk: we leggen [elders] de verantwoordelijkheid neer, waar die in mijn optiek hoort*"- respondent C).

6.5.2 Room to play - professional discretion vs. operational manual

The second cross-cutting pattern in the collected data is 'room to play' for the development actors. This space is signified by the discussion on professional discretion[70] and the embedded rules within self-created or imposed rules in operating manuals. Work by Lipsky (as reflected by Evans[71]) claims that there is an inevitability in policy work

[70] in: Evans, T. (2016). Professional discretion in welfare services: Beyond street-level bureaucracy: Routledge.

[71] (Evans, Tony 2016)

in public organisations regarding the desire of *street level bureaucrats* to both identify the need of flexibility in broader policy goals, and to work according to self-interest instead of organisational interest. These claims relate to the work by the teams (i.e. professionals) in the experimental RPAS projects. Regarding the first claim, manuals or by-the-book procedures are meant to secure constructive agreements for specific tasks, geographical areas, scenarios, procedures and technical operations. The operational agreements illustrate what to do in any given situation. In FDP however, these written agreements have already become problematic ("*we zijn gewoon heel beperkt: wat wij niet omschreven hebben, mogen we ook niet uitvoeren* (...) *dan zit je redelijk vast, ja* (...) *dus eigenlijk moet je ook* (...) *dingen heel breed omschrijven*"- respondents G and H). This concerns whether actors are capable of further experimentation, beyond what has been accepted as working practice: it may limit the actors of pursuing their own interests. However, agreements do not imply that there is no more 'room to play' when operational manuals have been published (which could be considered a 'threat' to professional discretion). Instead, the discretion actors already have (in practice) is supposed to be structured, which has been specifically been demanded ("*als je dat in een operationeel handboek gewoon goed beschrijft (…) kun je dat zelf- die ruimte ook wel creëeren natuurlijk*"- respondent D). Regarding the second claim whether professionals work according to their self-interest, the reaction by Evans (2016) about how professionals work with 'what they have' by applying policy in the best possible way available to them, both FDP and POL professionals do not seem to show any self-interest beside the enthusiasm related to working with new devices. There is a strict selection and there are educational requirements that make sure the professionals stay within the boundaries ('*het mag [gewoon] niet*' ; '*je bent zelf verantwoordelijk* (...) *zo niet, mag je het inleveren*' - respondent C). In short, the data show a narrow extent to which respondents in POL and FDP have professional discretion because of their approach to operational procedures manual and the plans for future deployment with RPAS.

6.5.3 Requirements for future technological development

Initially part of the design of this research, response on technological performance [T] does not appear to be prominent in the results of this study. The previously mentioned notion of *unstoppable train* can be found in multiple interviews, though. Beside the elements of the *unstoppable train*, actors seem to be fairly content with what is available. It does not appear that actors come around to make demands about payload systems. Respondents do list several reactive strategies. They look at what is for sale, and how expensive it is, in order to make cost-effective choices. No further effort is put in formulating technological performance other than *off-the-shelf* systems ("*wij gaan niet door-ontwikkelen in technologie: we kunnen hooguit aan leveranciers, of fabrikanten aangeven*"-respondent D).

However, the requirements for the future have been clearly mentioned in the interviews by the researcher as 'stimulant' in the discussion about further technological development. Respondent C clearly mentioned that is it premature to think about that ("*kennelijk was de tijd daar nog niet rijp voor*") and that the current project employees are satisfied with the available devices ("*geef je teamleden speelgoed en men is tevreden* (...) *ik zeg altijd: boys en toys*"). One could assume that users have certain demands, especially when it comes to being 'ahead of the development' or being a lead example. The data show that there is indeed a strategy think outside the current regimes and to look at newer possibilities, although the content of those possibilities is still not clear

("*buiten het kader* (...) *wat zijn de kansen en mogelijkheden?*" - respondent C). Granted, this strategy 'fits' with basic experimentation and does not exceed any financial or personnel limits. Regarding requirements for technological development, there are some dynamics patterns within the project organisations to gain insights and experience with available systems, and between actors in these project organisations to share those experiences and to come up with ideas for future deployment. These ideas can in turn be seen as requirements for the development, not such much as to performance[72], but more to functionality and uptake within the organisation.

6.5.4 Implications of the described patterns

This section aimed at answering the question: *what patterns can be found in public safety organisations, and what do these patterns show about ongoing learning about RPAS?* After having analysed the data collected in the interviews, there were three recurring patterns the data showed that could be related to previous studies in public administration.

The first pattern illustrated the concept of division of moral labour and how roles and responsibilities are divided. The data show that respondents believe there is a clear distinction in the organisation of their experimental projects, which is true for both roles within developmental groups, and between development actors and state actors. What stands out, is the way respondents cope with issues such as data protection or privacy- issues which are not relevant according to the respondents. It might be that the data are not extensive enough to say something about the relation between state actors and the project organisations, though. With this data, there is only inference to the best explanation- the current data show that in terms of moral labour, there is some form of presence of a clear division, perhaps even an inevitable one, following the Collingridge dilemma. Respondents are unaware who will continue the projects after being completed. Moreover, there is some consideration of future role division about how drones are treated within public safety operations (e.g having both a pilots' and drivers' license). The role of drones within the organisation then adds to the organisational opinion about drones as being part of the armoury, instead of being a stand-alone device. This pattern is important in the *maatschappelijk krachtenveld*, since it illustrates the relation between operational and state actors, which is based on trust. Trust can be beneficial for learning to work with drones, since it pushes the development forward without the need for specific requirements or guidelines.

The second pattern compares professional discretion to working by-the-book (i.e. according to an operational procedures manual). The respondents believe their current experiments contribute to the operational possibilities of RPA systems in public safety operations in the future. However, actors do not have a lot of discretion, which is signified by the current absence of self-interest and the way project employees need to be strict in defining flight procedures. If pilots or developers encounter issues or possibilities with the technology or flight scenarios in the future, they will be unable to record these in a manual if said manual is not open to new findings. The project actors will need to think about a way to record or communicate new findings. It is difficult to say whether an operational manual will play a role in this future communication.

[72] as introduced in the Theory chapter

The third pattern illustrated the requirements for future possibilities. The respondents have shown that there is still a lot to gain in the projects and that they are -to some degree- thinking about possibilities beyond the experimentation space. Perhaps there is a role for state actors encourage additional steps in the implementation process while the projects are still advancing. The next section will address this role for state actors, and the required information needed for the project participants.

6.6 Possible state interventions

In the development of RPAS, and specifically for national police and fire department, their optimal deployment, and the learning that is necessary, is recognised as important- this is the purpose of the experimental projects. The focus is on the real-time operations the actors have to perform. This appears to work, but participants in the projects appear to not proactively consider technological requirements for future operations. This might change, though: the respondents in this study did -to some degree- show an interest in future technological possibilities which they might take up.

One could ask whether government interventions would be helpful to improve the learning process. This questions actually relates to the whole range of policy instruments that governments can employ. I will briefly consider possibilities, and then move to discuss possible scenarios, because such an approach allows room to address complexities.

6.6.1 Public policy instruments

Governmental interventions directly or indirectly addressed to development actors could incentivise actors (e.g. with additional funds or legally creating more space to experiment). As I noted before- there are in general three types of public policy instruments[73]: carrots (incentivising and enabling), sticks (punishing or discouraging) and sermons (persuading). These three types of policy instruments will be used to discuss possible moves[74] that state actors can make towards development actors.

- *Carrots* are enabling or incentivising measures to steer a certain process. As Bemelmans-Videc et al. (2011) explain, these are usually regulatory means, or mandates. Mandates refer to rules that govern the actions of organisations and can be obligations for (not) taking action[75]. These rules could be linked to the future regulation of RPAS; respondents in this study have mentioned that currently, unmanned aerial vehicles are covered by legislation for model airplanes. Previously in this study, I mentioned that the project organisations view UAS's not as stand-alone vehicles, but as 'cameras with wings'- focusing on the performance of the payload, not the device itself. If state actors should decide to create new legislation, RPA systems could be viewed from a different legal standpoint than currently is the case, for example by focusing on the payload type instead of the aerial vehicle. This enables public safety organisations to experiment with UAVs beyond legal restraints- something they currently are unable to do, because of each individual experiment's request for legal

[73] (Lascoumes & Le Galès, 2007, Rajabifard, 2011, Bemelmans-Videc et al., 2011)

[74] the term 'moves' is chosen to signify activity in the developmental 'game'

[75] (Abbas Rajabifard 2011)

exemption. Another type of incentivising policy instrument are inducements: providing funds in return for production or services, or enabling actors to investing in human, material and/or intellectual resources. Respondents have mentioned that cost-effective measures impede the efficiency of the experimental projects-additional funds for investing in human resources or for the purchase of (certain parts) of unmanned aerial systems, could be beneficial to the overall learning process. State actors are able to provide these additional funds, which creates more room for learning and development.

- Governmental intervention can also be done by using *sticks*; punishing or disabling policy instruments. These could refer to legislative impediments, such as strict rules for flying with unmanned aerial vehicles. Currently, the rules for flying with UAV's are already quite strict and there is not much room to operate for recreational use. If the same rules would apply for public organisations such as the police and fire department, the experimental projects would probably have not much room to operate. An operational manual would also be quite strict and influenced by top-down decisions, instead of the current bottom-up 'learning-by-doing' strategy. Although top-down requirements could be an effective and relative fast strategy to create an operational procedures manual, it can be unfavourable for development actors because they lose the opportunity to further experiment with drone flight scenarios. Furthermore, it might cause distress with individuals, since they are losing the freedom to operate within the projects, which the respondents think is valuable.
- *Sermons* refer to persuasion, particularly how it works on organisational levels. Government could send a signal that some goals or actions are considered a high priority. For instance, if operational procedures are more likely to succeed when more research is conducted, state actors could provide additional knowledge to the projects. It might be possible to announce grants for universities or by involving research institutes. Another option is that the state would intervene in the project monitoring to inform both the national police and fire department of each other's progress.

6.6.2 Three scenarios for state intervention

The scenarios I propose here are not recommendations -as consultants would offer them- but exercises that highlight certain options and allow some evaluation. I have no data on how state actors view these options, even if I can speculate. Three different approaches are distinguished: no additional support, direct and perhaps discouraging intervention, and soft and incentivising intervention:

I. *No additional support* - state actors have confidence in the ability of the experimental projects to further develop autonomously. Development actors keep experimenting with the available *off-the-shelf* technology and they keep receiving incidental requests for real-life operations. Uptake of the technological innovation within the project organisations will not require additional funds and development actors are not proactively searching for supporting legislation. The projects will eventually be converted to an additional and integral part of the existing national police and fire department organisations. Project employees will either continue working in these newly formed organisations or be transferred to a different unit.

II. *Deciding to take over* - state actors conclude the project organisations have not been innovating effectively given the current learning-by-doing methods in the projects. They decide to strictly monitor and evaluate the experimental projects. Additional funds will only be provided to parts of the projects that are proven to be effective for the innovative process; state actors will give specific permissions and legal exemptions for further experimentation and real-life operations; when the projects have been concluded and evaluated, the state will decide how RPA systems will be treated legally; top-down established operational procedure manuals will be the primary source of information for future operational use.

III. *Improve learning by incentivising* - state actors apply policy instruments to incentivise, coordinate and enable development actors to work more effective in obtaining knowledge through experimentation. These policy instruments can include -but are not limited to- treating RPA systems from a different legal perspective (i.e. not as model airplanes); legally providing experimentation space for operations both inside and outside of the project organisations, so that individual requests for legal exemption are no longer necessary; providing additional funds to contribute to the education of new pilots, for the purpose of purchasing and repairing vehicles and funding for research and development institutes and drone manufacturers; taking on the role of *first customer* by placing requests (e.g. for state-related events where (live) aerial camera footage is desirable).

Given the thrust of the central research question of this study, it is interesting to think about the implications of state actor intervention and to evaluate which of these scenarios will be the most productive. That is, addressing the sub-question: *how can state actors incentivise or (unintentionally) discourage the process of future RPAS innovation and its embedding in society?* The third proposed scenario would probably be the most productive, since it will support the project actors in the learning process and it makes sure the already obtained knowledge is retained. The other scenarios will be less productive: no intervention at all does not improve learning, and direct intervention can cause the projects to be finished abruptly, ultimately eliminating the possibility to obtain further knowledge in protected experiential spaces.

7
Conclusions

In our innovation-driven society, the emergence of technological innovations is both promising and dangerous. Because of the uncertainties the innovation of remote piloted aircraft systems (RPAS, or: drones) entails, it is crucial for public safety organisations to learn how to work with drones in their own law enforcement operations. In addition, there should be a productive environment in which actors are able to experiment with functionalities of a new technology. This study has made a contribution to understanding which elements are influencing the learning process and how state actors can incentivise or (unintentionally) discourage the process of further RPAS innovation. Specifically, in this study the following research question has been addressed: *how could actors improve the learning process of working with drones in a public safety domain?*

7.1 Learning process

The results of this study showed that actors in public safety organisations are effectively working together to learn about the functionalities of drones, with the purpose of implementing aerial surveillance devices in their operations. The process of learning to work with drones is constructive because it makes sure that actors are deliberately thinking about the possibilities a new technology brings to improve public safety. Two projects have been constructed, one for the national police (Project Onbemande Luchtvaartuigen [POL]) and one for the fire department unit in Twente [FDP]. Actors in POL and FDP are enthusiastic about the functionalities of drones and see them as an addition to the current armoury, rather than replacing the existing surveillance devices. Their constructive attitude contributes to the prospering of the innovation of RPAS, one aspect being that actors are able to work in parallel to discussions in the media in the past few years. Furthermore, collaborations with the Ministry of Defence and practicing real-life operations are beneficial to learning how to work with drones. It enables actors to gain experience beyond the boundaries of experimental spaces. FDP members have responded that they are already carefully introducing the functionalities of RPAS in current firefighting operations, which inspires their colleagues to learn about added value of working with drones. In light of these results, it can be concluded that actors not only learning to work with drones, but are also investing in the relations in the *maatschappelijk krachtenveld* of drone development.

Still, there are aspects in the learning process that limit learning about working with drones and may affect future implementation of drones in a public safety domain. First, the duration of the projects is longer than initially planned and there are no fixed deadlines that put pressure on the efforts. Second, the project actors are specifically focusing on solving practical problems and the uptake of technology in their own organisation (e.g. looking for new personnel; making cost-effective choices for devices and repairs; carefully introducing drones to existing law enforcement units), rather than the uptake in society (e.g. what impact drones will have on privacy). Given the current discussion and uncertainties about drones, actors should not solely focus on internal

organisational challenges, but also on the consequences of drone deployment outside the projects and on the relationship between them and non-project actors. Third, although actors are thinking about future possibilities (e.g. fire extinguishing or covert operations), they are not actively looking for what is needed to accomplish this. Either manufacturers could propose novel techniques or systems, or project actors could generate demand for such technological possibilities. This is an indication that actors are currently limiting the possibilities of future drone deployment. They should therefore embrace future technological developments. Fourth, the results of this study indicate that there is no monitoring or oversight by state actors. The government has, however, expressed confidence in the projects. The obtained knowledge is shared within the project team, not with other colleagues or with state actors. If local units will continue to work with drones in the future, it would be advisable to share experiences with other actors. This could be achieved by creating an online knowledge database.

The results indicate that the experimental projects provide a lot of new information of and understanding about the use of drones. However, the problems encountered by the actors are often difficult to solve by the actors alone. Although the project actors are primarily focused on overcoming practical challenges, they do not contribute to the next step in the development of drones nor are they proactively adapting to the future functionalities.

7.2 Discussion

It is difficult to say whether the results of this study are generalisable for the implementation of RPAS in public safety operations, for at least two reasons. First, the implementation of RPAS is a process in which not many individuals are included; this study merely explored the individuals that were available for interviews due to time constraints. Secondly, it might be presumptuous to relate the results of this study to innovation of different technological innovations. Drones differ from innovations such as nanotechnology, bio technology, or even driverless cars, in a way that the drones are already widely available- the innovation lies with novel functionalities.

This study was valuable for determining actor perspectives about the implementation of the technology. Still, it might have been more productive to have structured interviews based on a few discussion points (e.g. by predefining tensions, dilemmas, etc.). The used semi-structure allowed respondents to put more emphasis on topics they deemed important, and these topics were often included in future interview sessions. A structured interview could prevent this researcher's bias. It was difficult to focus on topics other than what was already available in policy and study reports about drones[76]. In addition, the recurring patterns that were found and discussed in this study, could be presented to the project actors in a second round of data collection. Regarding the research design of this study, the explored elements of [T] and [E] were based on earlier work by Robinson et al. (2007), Bennertz (2014), Deuten et al. (1997) and Rip (2014). One important limitation is a result of the fact that only the work of these authors was used for this study's research design. Despite the fact that these studies are critically looking at technology assessment, the literature background of this study may have been biased since only the work by these authors was researched.

[76] which primarily focus on societal uptake such as data protection and privacy issues

There are some explanations as to why the chosen [T] and [E] elements were not as prominently present as in earlier work by these authors. One reason may be that this study has performed an incorrect or incomplete technology assessment. Another reason may be that drones do not 'fit' in the work by the authors mentioned above. If however, the results of this study do represent the current affairs, it may be due to the current organisational climate in national (and regional) safety organisations. The results of this study may be based on the assumption that the explored national organisations are not sure yet sure about how to deal with new (technological) innovations. A clear strategy that includes responsible experiments with partners in the safety domain is not practiced. This is not a new situation- effective introduction of new communication systems and effective effective use of data in chain cooperation has been an unsolved issue for many years now. This current organisational climate may not allow for drastic changes in operations or the way the organisations work proactively with new innovations. In summary, the challenge of this study was to combine processes of organisations and technological innovations, but it appears to be difficult to make informed statements about administrative division or the role of actors in a developmental 'game'. This may be due to the fact that the types of (semi-)public organisations studied here are not suitable for analysis about the uptake of technology or patterns in public administration. Further studies are needed to estimate *de facto* drone innovation strategies in the public safety domain, for example by looking at discussions about privacy, data protection or liability.

An advice for further research could include several interesting things. Primarily, it might be interesting to assess drone technology and its impact on the concerned organisations by evaluating the current experimental projects once they have been completed. This research might also result in a better understanding of impact and ways to study it. It is also interesting to pursue research about technological performance and uptake of drones in society. Other research could focus on administrative division of tasks in technological innovation, beyond the current separate analysis of merely police, fire department and the Ministries. One could expect that some generic lessons could be learnt regarding the impact of drones on these organisations, if joint or comparative studies would be conducted. Alternatively, one might assess the effectiveness of policy implementation based on the recently released Strategic Knowledge and Innovation Agenda (SKIA), which illustrates policy goals for the next three years. This is an important field of research, as it could set out sound conditions for effective innovation and implementation of new technologies in the frame of national safety police and organisation. There are inspiring lessons to be learnt from foreign research- for example in Fairfax about the potential of technology in policing. Recommendations by Koper et al. (2015) illustrate that in police organisations, technology should be adapted after organisational norms have been established, that there should be a long-term commitment to technological advancements, and a focus on maximisation of participation with personnel that is affected by technological changes[77]. These recommendations from the US pose an engaging topic for exploration for implementation of drones in the Netherlands, in particular where experimental projects are still under development. Another interesting topic that is still open for further research concerns the deployment of drones at large-scale events or by local units (e.g. municipalities). The topic of digitalisation in safety domains is interesting from the perspective of street-level professionals; future studies should explore how professionals are collaborating in these safety network-domains, and how citizens are included in the process of developing technological innovation.

[77] (Koper et al., 2015, p. 249-252)

7.3 Propositions on a state policy for drones

Based on the results of this study, it can be concluded that the actors should use the available experimental space to exploit the full potential of working with drones. Encouraging project actors to include discussions in the current projects about implication of future deployment is therefore recommended. State actors are able to influence the projects with the use of policy instruments. To illustrate the effects of governmental influence, this study proposed three possible scenarios for interventions by state actors.

First, state actors can opt not to intervene, wait until the project leaders have finished the projects and have finalised operating procedures manuals. Afterwards, state actors evaluate the projects and decide whether additional measures are needed or if drones are suitable for immediate deployment. The project actors continue to overcome practical impediments. While remaining in a safe experimental space, project actors might not take up the opportunity to explore future possibilities. It is therefore unlikely that the knowledge of working with drones will be extended. This scenario suggests that state influence does neither incentivise nor discourage the project actors. Second, state actors conclude that the projects have failed. They set specific deadlines for the projects, make top-down decisions for operating procedures manuals and provide specific legal exemptions for drone operations. Although this scenario ensures the projects and manuals are completed, the dynamic trust-based relation between the various actors will be weakened. Moreover, making top-down decisions for an autonomous project (unintentionally) discourages the project actors from further improving their learning process. Third, state actors can encourage the project actors to pursue their interest in formulating performance requirements by providing them with additional funding for vehicle purchase, repairs and education of pilots. State actors can also provide incentivising funds for research and development institutes and RPAS manufacturers. In this scenario, state actors create general legal exemptions for fly-zones and experimental spaces. This eliminates the need to request individual legal exemptions. It is possible, therefore, that state actors encourage the project actors to increase the frequency of the operations. In addition to overcoming practical issues, project actors are able to focus on future operational strategies.

In light of these considerations, the third scenario would be the most productive, since it will support the project actors in their learning process and it retains the obtained knowledge. The other scenarios might be less productive, considering no intervention at all does not improve the current results of the projects, whereas direct intervention can cause the projects to finish abruptly. This ultimately eliminates the obtainment of further knowledge in protected experimental spaces.

In summary, this study is the first step towards enhancing our understanding about how public safety actors are learning to work with drones and how this can be improved. While the projects are still continuing, there will need to be additional steps to improve the learning process of the experimental drone projects. Eventually, police and fire department should think about the implementation of RPAS in their operations after the projects are completed. Additional moves are required by both project actors for overcoming practical challenges, and by state actors to improve the learning process and effectiveness of the projects. Drones are here to stay- the question to be asked is whether improved dynamic interactions between state actors, police and fire department can ensure drones will be handled productively and legitimately.

8
References

Bemelmans-Videc, M.-L., Rist, R. C., & Vedung, E. O. (2011). Carrots, sticks, and sermons: Policy instruments and their evaluation (Vol. 1): Transaction Publishers.

Benioff, D., & Weiss, D. B. (2011). Game of thrones. *USA: HBO*.

Bennertz. (2014). The brazilian ethanol car: A sociotechnical analysis (O carro brasileiro a álcool: uma análise sociotecnica).

Bennertz, R. (2014). The brazilian ethanol car: A sociotechnical analysis= O carro brasileiro a álcool: uma análise sociotecnica.

Blok, S., & Dijkhoff, K. (2017). *Strategische Kennis- en Innovatieagenda (SKIA)*. Den Haag: Rijksoverheid Retrieved from https://www.rijksoverheid.nl/ministeries/ministerie-van-veiligheid-en-justitie/documenten/publicaties/2017/05/18/strategische-kennis-en-innovatieagenda-skia.

Boucher, P. (2015). Domesticating the drone: the demilitarisation of unmanned aircraft for civil markets. *Science and engineering ethics, 21*(6), 1393-1412.

Brownsword, R. (Producer). (2012). Regulating Technologies. *Oxford Internet Institute*. [YouTube Video] Retrieved from https://www.youtube.com/watch?v=IVBUBT1zzGg

Brownsword, R., & Somsen, H. (2009). Law, innovation and technology: before we fast forward—a forum for debate. *Law, Innovation and Technology, 1*(1), 1-73.

Clarke, R. (2014a). Understanding the drone epidemic. *Computer Law & Security Review, 30*(3), 230-246.

Clarke, R. (2014b). What drones inherit from their ancestors. *Computer Law & Security Review, 30*(3), 247-262.

Clarke, R., & Moses, L. B. (2014). The regulation of civilian drones' impacts on public safety. *Computer Law & Security Review, 30*(3), 263-285.

Cole, C. (2016, 2016-05-31). Reviewing the current debate on drones. Retrieved from https://dronewars.net/2016/05/31/reviewing-the-current-debate-on-drones/

Deuten, J., Rip, A., & Jelsma, J. (1997). Societal embedding and product creation management. *Technology analysis & strategic management, 9*(2), 131-148.

Dictionary, O. E. (2007). Oxford English dictionary online: JSTOR.

Dijksma. (2016). Kamerbrief over maatregelen drones. Retrieved from https://www.rijksoverheid.nl/documenten/kamerstukken/2016/04/22/beantwoording-vragen-schriftelijke-overleg-drones [letter to parliament]

EC. (2017). Aviation: Commission is taking the European drone sector to new heights [Press release]. Retrieved from http://europa.eu/rapid/press-release_IP-17-1605_en.htm

EP. (2017). Joint motion for a resolution on the use of armed drones. Retrieved from http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+MOTION+P7-RC-2014-0201+0+DOC+XML+V0//EN

Evans, T. (2016). Professional discretion in welfare services: Beyond street-level bureaucracy: Routledge.

Finn, R. L., Wright, D., Jacques, L., & De Hert, P. (2014). Study on privacy, data protection and ethical risks in civil Remotely Piloted Aircraft Systems operations: Final report. *Retrieved February, 27*, 2015.

Freeman, P., & Freeland, R. (2014). Politics & technology: US polices restricting unmanned aerial systems in agriculture. *Food Policy, 49*, 302-311.

Heldeweg, M. A. (2010). Smart rules & regimes: publiekrechtelijk(e) ontwerpen voor privatisering en technologische innovatie: University of Twente.

Holmstrom, B., & Milgrom, P. (1991). Multitask principal-agent analyses: Incentive contracts, asset ownership, and job design. *Journal of Law, Economics, & Organization, 7*, 24-52.

Hook, L. (2016). Uber launches first self-driving taxi fleet. *Driverless Cars*. Retrieved from https://www.ft.com/content/bd0f43fe-7a2a-11e6-ae24-f193b105145e

Hussain, M. (2017). U.S. Has Only Acknowledged A Fifth of Its Lethal Strikes, New Study Finds. Retrieved from https://theintercept.com/2017/06/13/drone-strikes-columbia-law-human-rights-yemen/

Jansen, P. H. (2015). The Ethics of Domestic Drones: An Ethical Evaluation of the Use of Surveillance-Capable Unmanned Aerial Systems in Civil Contexts.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of financial economics, 3*(4), 305-360.

Kingdon, J. W. (1995). Agendas, Alternatives and Public Policies (2nd ed.). Boston: Longman.

Koper, C., Lum, C., Willis, J. J., Woods, D. J., & Hibdon, J. (2015). *Realizing the Potential of Technology in Policing*. Retrieved from Fairfax, Virginia: http://cebcp.org/wp-content/technology/ImpactTechnologyFinalReport.pdf

Kroes, P., & Meijers, A. (2002). The Dual Nature of Technical Artifacts-presentation of a new research programme.

Lascoumes, P., & Le Galès, P. (2007). Introduction: Understanding public policy through its instruments—From the nature of instruments to the sociology of public policy instrumentation. *Governance, 20*(1), 1-21.

Latour, B., & Woolgar, S. (1979). Laboratory Life. Beverly Hills. *Calif.: Sage*.

Lipsky, M. (2010). Street-level bureaucracy, 30th ann. Ed.: dilemmas of the individual in public service: Russell Sage Foundation.

Martin, G. R. (1996). *A Song of Ice and Fire*: Bantam Books.

Mohammed, F., Idries, A., Mohamed, N., Al-Jaroodi, J., & Jawhar, I. (2014). *UAVs for smart cities: Opportunities and challenges.* Paper presented at the Unmanned Aircraft Systems (ICUAS), 2014 International Conference on.

Mulder, K. (2006). Sustainable development for engineers: A handbook and resource guide: Greenleaf Publishing.

NLR. (2017). Professional RPAS (Drone) Operations. Retrieved from http://www.nlr.org/capabilities/professional-rpas-drone-operations/

Parandian, A. (2012). Constructive TA of Newly Emerging Technologies Stimulating learning by anticipation through bridging events: TU Delft, Delft University of Technology.

Parandian, A., Rip, A., & Te Kulve, H. (2012). Dual dynamics of promises, and waiting games around emerging nanotechnologies. *Technology analysis & strategic management, 24*(6), 565-582.

Politie. (2015). *Visie op sensing.* Den Haag.

Rajabifard, A. (2011). Public Policy Instruments. Retrieved from http://www.csdila.unimelb.edu.au/sis/Public_Policy_Theories/Public_Policy_Instruments.html

Rijksoverheid. (2016). Risico's van drones. Retrieved from https://www.rijksoverheid.nl/onderwerpen/drone/inhoud/risicos-van-drones

Regeling modelvliegen, (2017).

Rip, A. (1992). Between Innovation and Evaluation: Sociology of Technology Applied to Technology Policy and Technology Assessment. *RISESST. Rivista di studi epistemologici e sociale sulla scienza e la technologia, 1992*, 39-68.

Rip, A. (2005). Socio-technical landscapes, geographies of responsibilities, and the 'constitution' of our technological society. *In: Analyse van Technologie in de Samenleving* [Study reader]. Enschede: University of Twente.

Rip, A. (2014). The past and future of RRI. *Life Sciences, Society and Policy, 10*(1), 17. doi:10.1186/s40504-014-0017-4

Rip, A. (2017). Division of Moral Labour as an Element in the Governance of Emerging Technologies. In D. M. Bowman, Stokes, E., Rip, A. (Ed.), *Embedding New Technologies into Society: A Regulatory, Ethical and Societal Perspective* (pp. 113-127). Stanford: Pan Stanford Publishing Pte. Ltd.

Robinson, D., Ruivenkamp, M., & Rip, A. (2007). Tracking the evolution of new and emerging S&T via statement-linkages: Vision assessment in molecular machines. *Scientometrics, 70*(3), 831-858.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.): Simon and Schuster.

Schomberg, R. v. (2015). From 'Responsible Development of Technologies' to Responsible Innovation. Retrieved from https://renevonschomberg.wordpress.com/from-responsible-development-of-technologies-to-responsible-innovation/

Schörnig, N. (2013). We Need the Drone Debate - But Do We Need the Drones? Retrieved from https://us.boell.org/sites/default/files/downloads/Schoernig_Drone_Debate.pdf

TheEconomist. (2017a). Drone technology has made huge strides. *The Economist.*

TheEconomist. (2017b). The future of drones depends on regulation, not just technology. *The Economist.*

Trogdon, K. (2017). Law Enforcement Officials Look to Drones as Way to Improve Public Safety. *The News Observer.* Retrieved from http://www.govtech.com/em/safety/Law-enforcement-officials-look-to-drones-as-way-to-improve-public-safety.html

Tucker, A. W. (1980). On Jargon: The Prisoners' Dilemma. *UMAP journal, 1*(S 101).

Van der Meulen, B. (1998). Science policies as principal–agent games: Institutionalization and path dependency in the relation between government and science. *Research policy, 27*(4), 397-414.

Vandersteen, W. (2017). Suske en Wiske - Game of drones (Vol. 337, pp. 48).

WODC. (2015). *Het gebruik van drones: een verkennend onderzoek naar ombemande luchtvaartuigen.* Retrieved from https://www.wodc.nl/onderzoeksdatabase/2518-gebruik-van-drones.aspx?nav=ra&l=geografisch_gebied&l=europa

Xinhua. (2017). China Focus: Fly high: Chinese solar drone "Rainbow" reaches near space. Retrieved from http://news.xinhuanet.com/english/2017-06/13/c_136363018.htm

9
Appendix I - Glossary

CTA	[*acronym*] Constructive Technology Assessment (type of research process focused at forming public and political opinions of societal elements of science and technology)
DGPol	[*acronym*] Directoraat-Generaal Politie
Drone	[*slang*] unmanned aerial vehicle/system
[E]-scale	measurement scale for societal embedding and uptake of technology
EC	[*acronym*] European Commission
EP	[*acronym*] European Parliament
FDP	[*acronym*] Fire Dept. Pilot - RPAS project at Brandweer Twente
FLIR	[*acronym*] Forward Looking Infrared (type of infrared camera)
MK	[*acronym*] Maatschappelijk Krachtenveld: a socio-technical 'field of forces' with dynamics relations between developing actors in technological innovation processes
Operational actors	actor group which signifies developing project organisations (i.e. POL and FDP; not excluding others)
Payload	cargo a drone carries (can be a camera)
POL	[*acronym*] Project Onbemande Luchtvaartuigen (*Project unmanned aerial systems*)
R&D	[*acronym*] Research and Development (often referring to a specific department, unit or center within an organisation)
RPAS	[*acronym*] remote piloted aircraft system
State actors	actor group which signifies governmental organisations (i.e. Ministries; legislative and regulatory actors and other political actors)
TA	[*acronym*] Technology Assessment (see CTA)
[T]-scale	measurement scale for technological performance
UAS	[*acronym*] unmanned aerial system
UAV	[*acronym*] unmanned aerial vehicle

Appendix II - tables and figures

Table I: statement linkage modalities

(Robinson et al., 2007, p. 840) and (Bennertz, 2014, p. 48)

Statement linkage modality	Description	Action implied
Science fiction	It may happen (accepted as fantasy)	No
Visionary Linkage	It may happen (accepted as reality based fantasy)	No
Guiding Vision	It may happen	Yes
Expectation Linkage	It will happen	Yes
Agendas (goals)	We are gonna make it happen	Yes
Preliminary use	We need further development to live up to technological promises	Yes
Unproblematic acceptance	We could still develop further to achieve even better performance results	Yes
Proof (proven and/or demonstrated)	We have made it happen (accepted as fact/reality)	Yes

Figure I: forked scale for societal embedding and uptake

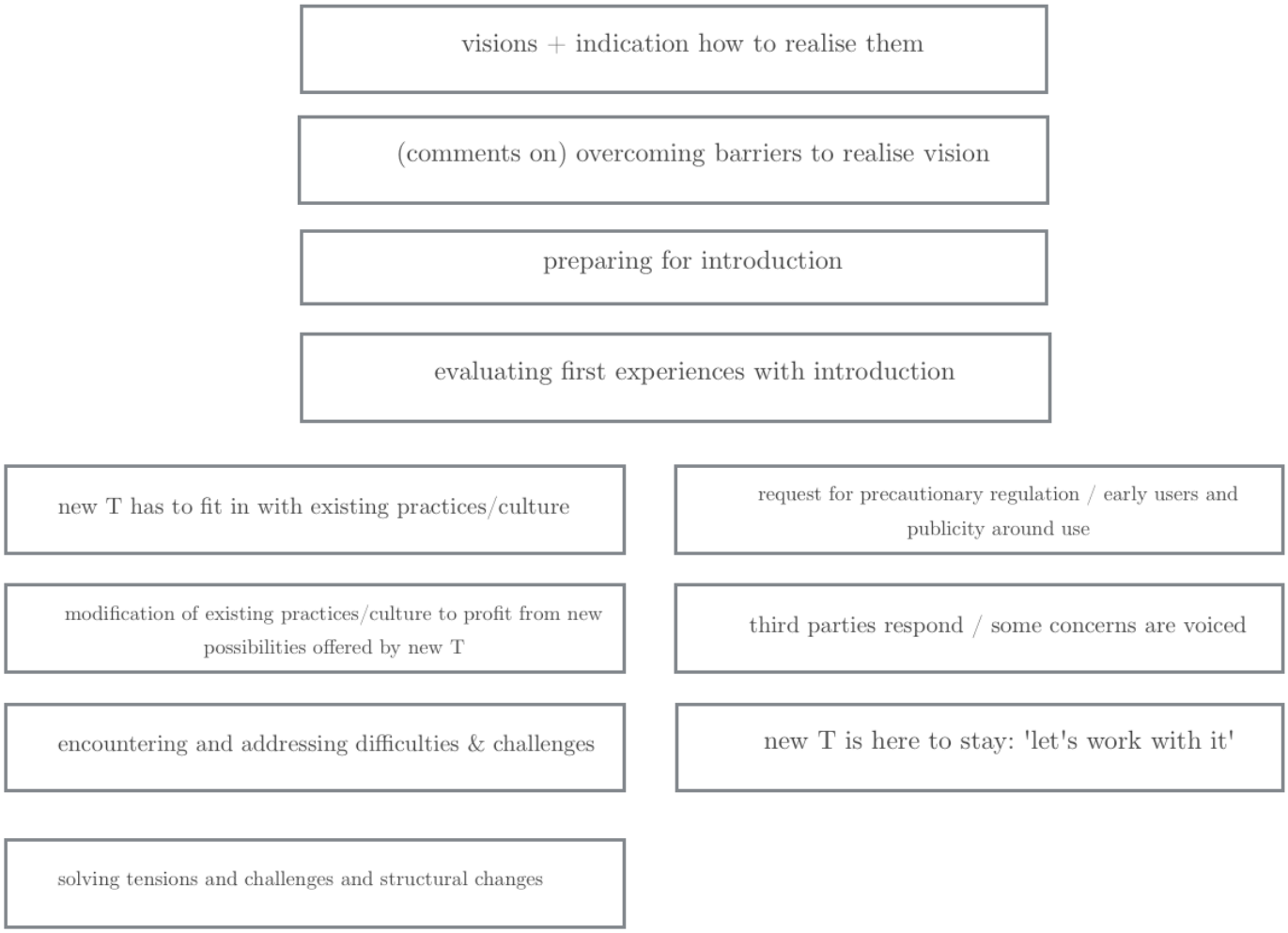

Table II - interview respondents and transcription references

Transcription reference	Date	Organisation / Location	Background interviewee(s)	Respondent reference (in transcriptions)	General topic of the interview
UT-MPA-drones-01	02-01-17	Directorate-General National Police / Ministry of Security and Justice, The Hague	Policy employees (2)	A, B	The development of drones at the Ministry and national police
UT-MPA-drones-02	09-01-17	Dutch Police / National Police Unit, Driebergen-Zeist	Project leader 'Project Onbemande Luchtvaartuigen' [POL] (Project Unmanned Aircraft)	C	The development and application of drones in POL
UT-MPA-drones-03	14-02-17	Brandweer Twente (Fire Department Twente) / Twente Airport, Enschede	Project leader experimental pilot and operations at Brandweer Twente	D	The development of drones in the Fire Department's experimental pilot
UT-MPA-drones-04	27-02-17	KLPD Dienst Luchtvaartpolitie (Aviation Police) / Schiphol-Oost, Schiphol Airport	Operation Coordinator Aviation Police	E	The development of drones at Luchtvaartpolitie
UT-MPA-drones-05	28-02-17	KLPD Dienst Luchtvaartpolitie (Aviation Police) / Skype meeting	Specialised Employee POL	F	The development of drones at POL, pilot education and certification
UT-MPA-drones-06	07-03-17	Fire Department Twente / Twente Airport	RPAS pilots (2)	G, H	RPAS operations at Brandweer Twente
UT-MPA-drones-07	09-03-17	KLPD Dienst Luchtvaartpolitie (Aviation Police) / Schiphol-Oost, Schiphol Airport	Deputy project leader POL	I	Drones and POL: legal aspects
UT-MPA-drones-08	21-04-17	Dutch Police / the Gallery, University of Twente	Project leader 'Project Onbemande Luchtvaartuigen' [POL] (Project Unmanned Aircraft)	C	POL: project construction, methodology, monitoring and evaluation

This page has intentionally been left blank.