Master's programme in Techno-anthropology - thesis

DISCOVERING DRONES IN DENMARK

Could it be different?

An analysis of a drone development path creation in Denmark through practices.

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Abstract

In this paper we explore the potential of using multiplicity and performativity as tools for a critical analysis of a drone development path creation in Denmark. We approach the field with an ethnographic multi-sited research design allowing us to track the phenomena of civil drones through multiple sites in Denmark.

We describe practices enacting and performing different realities and how these realities get related together in practice. We find that some practices seem as converging, in what appears singular and dominating. We consider how this both enables and restricts the development path creation, and creates the potential for change. We explore this by considering a handful of actors, who we identify as influential in the Danish drone development path creation. We treat the actors performatively and ask; what might happen if the dominant practice is re-multiplied and recognizes and responds to 'hidden controversies' of civil drones? We conclude that subordinate practices are enacted alongside dominant practices, and by re-multiplying the dominant practice the subordinate practices can prove to be an important resource for the development path creation.

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1.0 Introduction

"Drones are here". That is the title of a newsletter in 2013 to the Danish government from the Danish Board of Technology (Fonden Teknologirådet 2013).
Unmanned aerial systems, unmanned aircraft systems (UAS), unmanned aerial vehicles (UAV) or remotely piloted aircraft systems (RPAS) or simply 'just' referred to as *drones*, have been known in a military context from the wars in Afghanistan and Iraq but in recent years 'civilian drones' are gaining attention (Teknologisk Institut 2016). Civilian drones are an emerging technology that is increasingly adopted in the private and public sector and even for leisure by private persons. Civilian drones are portrayed in news media and reports as ''(...) *a real opportunity to foster job creation and a source for innovation and economic growth for the years to come*'' (European Commission 2014a: 9). There exists a worldwide euphoria surrounding the potential of civilian drones (Teknologisk Institut 2016). Their potential benefits for the economy, environment and society seem unlimited. In 2015 the Danish government officially stated that Denmark should be a leader and frontrunner in the civilian drone industry as the Danish Minister of Transport and Building, Hans Christian Schmidt, proclaimed: "*Denmark must be a leading country in the drone field"* (Own translation from Danish) (Schmidt 2015a). In relation to this statement a law proposal for civilian drones in Denmark was developed, that will be enforced on September 1th. 2016. This was happening while this paper was prepared. Drones seem to have come to Denmark- and Denmark should lead the world in the drone development. This bold statement is what started the interests of this paper on civilian drones in Denmark, reminding us of the Danish adventure with windmills that successfully made Denmark a leading country of the industry (Garud & Karnøe 2001).
We perceive thereby civilian drones as a new technology in its early stage of development and implementation in Denmark. As techno-anthropologists, inspired by this definition of controversy as *" (...) every bit of science and technology which is not yet stabilized, closed or "black boxed"(…) we use it as a general term to describe shared uncertainty. (Macospol, 2007: 6, emphasis in original)"* (Venturini 2010: 260), we are drawn to the complex contemporary challenges associated with technology (Børsen & Botin 2013) combining " (…) *elements from the humanities and social science with elements from the natural and technical sciences"* (Børsen & Botin, 2013: 37). Therefore, one of the aims of this thesis is to

explore this new technology in the making. More precisely, taking inspiration from Garud & Karnøe (2001) we seek to explore the civilian drone development path creation in Denmark.

So what are civilian drones?

The broad definition of a civilian drone is any unarmed and unmanned vehicle controlled remotely with varying degrees of autonomy, this include ships, cars and aircrafts. But the most common definition, and the one used to describe civilian drones in Denmark, includes only aircraft. This definition is:

> "*A drone (UAV) is a fully or partially remote-controlled aircraft without a human person onboard. UAVs can be controlled with varying degrees of autonomy. Either by a degree of remote control from a remote operator on the ground, in another vessel or fully autonomously via computers onboard the drone*" (Own translation from Danish) (Teknologisk Institut 2016: 7).

This is a definition of a drone as a matter of technical details, but drones are more than this simple definition, for example does the Danish Minister of Transport and Building present drones as a tool for business *"Drones are a very exciting tool for business. It presents new opportunities for growth and development. Says Hans Christian Schmidt* (the Minister of Transport and Building)*"* (Own translation from Danish) (Transport- og Bygningsministeriet 2015). Drones are manifested in new and existing business practices; it is already applied in many practices such as monitoring, surveillance and movie production (Trafikstyrelsen 2015). Drones are present in laboratories where they are manipulated, shaped and reshaped. Drones might contribute to a different infrastructure flying around at low altitude affecting everyday life by challenging existing norms and regulations (Trafikstyrelsen 2015). Drones change depending on how they are practiced. This might be most obvious in the difference between civilian and military drones. Those two technologies are almost identical in the matter of technical details, many civilian drones are military drones without the weaponry, but they are very different, because, we argue, they are performed differently. Taking inspiration from John Law's perspective on material-semiotic and performativity we perceive drones as (...) *different things in different practices because it is being done or performed differently in those different practices* (Law & Singelton 2014: 384).

To return to the initial question *what are civilian drones?* We answer that drones are multiple, and thereby we abandon the idea that some objective reality must exists independently from what actors do. If we want to understand what drones are we have to investigate the practices that enact them. As we seek to explore the civilian drone development path creation in Denmark we need to do so by investigating the practices. *"Multiplicity is not plurality"* (Law & Mol 2008: 66), there are relations between the various enactments of the drone that both exclude and include each other. Approaching this investigation using *multi-sited ethnography* (Marcus 1995) enable us to 'trace' the drone in various contexts and among various actors observing their different practices and their relations. We ask, *what is a drone?,* as well we ask *how are* drones *done*?, with the objective of identifying how different sites connect to one another "*tracing the patterns of relations embedded in and reproduced in practices*" (Law & Singelton 2014: 380). Further we ask: what are actors doing? And does it have to be this way?
The multiplicity perspective implies ontological multiplicity as well, as Law concludes "*Realities and natures in the plural are endlessly being done alongside oneworld imaginaries*" (Law 2015:136), so reality is not destiny. In relation to the question of does it have to be this way? Multiplicity allows us to answer: no, realities might have been done differently. This paper therefore asks how could it be done differently? This question is relevant because there exist apparent dominant practices "(...) *enacting realities in ways that assume these to be generally, even universally, applicable"* (Singelton & Law 2013: 270), *oneworld imaginaries* that attempt to colonize subordinate practices.

1.1 Research questions

Our research question is two folded, and reads:

-How are drones, legislators, institutions, users and organizations interconnected and shape the development path creation in Denmark?
-What might happen if the dominant practices are re-multiplied and respond to subordinate practices of civil drones?

1.2 Clarification and delimitation

This paper draws on interaction with a handful of actors and therefore not a complete overview of the entire drone field. The actors were chosen specifically because of their work with drones, and informants with no affiliation to drones have not directly been included in the empirical work.

The study has been delimited to a Danish context for practical reasons. This does not imply that the Danish context might be similar or different to other countries. We draw on international papers and reports that research drone development because some have been utilized by actors in a Danish context, and others review relevant research.

2.0 Theoretical background

As suggested by the research question the overall framing of this thesis is strongly influenced by John Law's perspective on material-semiotic and performativity "*If we think performatively, then reality is not assumed to be independent, priori, definite, singular or coherent"* (Law 2009:1)

In this chapter we propose an understanding of Garud, Kumaraswamy, Karnøe (2010) path creation framework from a multiplicity-oriented ANT perspective. This, for some scholars conflicting, relationship between a social construction of technology framework and multiplicity-oriented ANT allow us to tell stories about generative patterns of relations embedded in and reproduced in practices that by connecting to one another are composing the creation of a technological path. The technological path is therefore in this paper a combination of heterogeneous reality and of what appears as oneworld imaginaries of colonizing practices.

2.1 The technological path

Broad interest, and studies can be found which try to understand innovation and how and why certain technologies or innovations succeed and other fail or become obsolete. This has been a topic of investigation from different perspective within the STS School. Pinch & Bijker (1987) studied the stabilization of artifacts by the Social Construction of Technology (SCOT) with their noteworthy study of the stabilization of the bicycle. Latour (1990) studied the evolution of Kodak and photography with an actor-network theory approach concluding that when actors, human and nonhumans, and points of view are aligned stability is achieved which looks like domination. De Laet & Mol (2000) argue for the success of the Zimbabwe Bush Pump for its quality as a fluid technology applying multiplicity (Post ANT) sensibility. As argued by Winner (1993) all these approaches can be broadly characterized as social constructivism approaches. Common for these newer studies of the 'evolution' of technology and innovation is their effort to bridge the technology/society divide, positioning some sort of agency to technological artifacts, whereby SCOT is focusing on human actors,

while Latour concludes "*Any thing that does modify a state of affairs by making a difference is an actor*" (Latour 2005:71)

A common approach to understand technological pathways has been the older economic theory of path dependency. This theory has been criticized by different authors for its assumption that random events such as historical events, chances, serendipity and external shocks in sequential actions fuel the creation of new technological pathways (Simmie 2011; Garud, Kumaraswamy, Karnøe 2010; Akrich et al. 2002a & 2002b; Garud & Karnøe, 2001). This theory, as Simmie (2011) concludes, claims that "*...the emergence of novelty and the consequential creation of new technological pathways is essentially a serendipitous process"* (Simmie, 2011: 756). Garud, Kumaraswamy, Karnøe (2010) note, this path dependency approach stirps agency from actors involved. Garud, Kumaraswamy and Karnøe (2010) propose therefore the path creation approach, where the path is cultivated and navigated by knowledgeable agents. Instead of new technologies emerge by 'chance'; they emerge through 'mindful deviation' from established paths (Garud & Karnøe, 2001). It is important to note, that Garud, Kumaraswamy, Karnøe (2010) do not argue that any single actor can fully determine the path creation but that they can only attempt to shape the unfolding process in real-time. Innovation is inherently heterogeneous and complex as described by Akrich et al. ''*An innovation in the making reveals a multiplicity of heterogeneous and often confused decisions made by a large number of different and often conflicting groups, decisions which one is unable to decide a priori as to whether they will be crucial or not*'' (Akrich et al. 2002a: 191).

2.2 The path creation

This paper proposes an understanding of Garud, Kumaraswamy, Karnøe's (2010) path creation framework from a multiplicity-oriented ANT perspective. Garud, Kumaraswamy, Karnøe (2010) and even more Garud & Karnøe (2003) analysis of the development of the Danish windmill takes its inspiration from SCOT (Simmie 2011). SCOT distinguishes from ANT in its focus on social groups whereas ANT sees symmetry between the human and nonhuman. The lack of non-human inclusion is noticeable in Garud & Karnøe (2003) analysis, but their later work, Garud, Kumaraswamy, Karnøe (2010), seems to be more

inclusive towards the non-human actors, arguing for socio-material entanglements as a consequence of and leading factor for agency.

2.3 The temporal understanding

Garud, Kumaraswamy and Karnøe (2010) describe how path creation encompasses three moments in time *"... the past (as in the use of the term 'path'), the future (as in the use of the term 'creation'), and the present (as in the conjunction of the two terms)"* (Garud, Kumaraswamy and Karnøe, 2010: 770). This points to an emphasis of studying the technological path in its making, avoiding therefore what Akrich et al (2002a) calls the trap of retrospective explanations. Retrospective explanations often use arguments such as absence of demand, technical difficulties or inhibitory costs as reasons for failure. Seen retrospectively those argument might seem as good explanations, but as Akrich et al (2002a) concludes, when innovation is in the making those arguments are highly controversial and not obvious. The study of technological path in its making do not exclude analysing past events, but as Garud, Kumaraswamy, Karnøe (2010) emphasize the importance lies in placing oneself at the time that events occurred when studying them. This temporal understanding can be found in various multiplicity-oriented ANT studies, such as De Laet & Mol (2000) analysis of the success of Zimbabwe bush pump type (B) and Law & Singleton (2014) study of the foot and mouth disease epidemic, to name a few, where an attempt is clearly made to understand the time that the events occurred. Our study of drones is a study effectuated when innovation is in the making and where the path is not more or less stabilized. We are 'forced' to study the events as they occur. The combination of the two will help us understand the controversy of the present technological path in *the making* by telling a story about relations through time and present practices.

2.4 Agency

As stated previously, anything that changes the current state acts. Agency, according to the Oxford English Dictionary (2016) is defined as ''*Action or intervention producing a particular effect: canals carved* ***by the agency of*** *running water*'' (Oxford Dictionary 2016).

According to this definition, there should be no issues for attributing agency to humans and non-humans alike. Some might argue that non-humans are not reflexive and cannot have intentionality, thereby joining agency with intentionality, as indicated in De Laet and Mol (2000) and Law and Mol (2008). In this paper, following Garud, Kumaraswamy, Karnøe (2010) and Garud & Karnøe (2001) theory of path creation, agency is distributed and actors do not act alone. Referring to Law and Mol (2008) argumentation, if an actor does not act alone it acts in relation to others. If an actor does not act alone, it simultaneously acts and is acted upon or in other words enacted (Law and Mol 2008). Action is thereby fluid, always acted upon, therefore intentionality, mastery and reflexivity are not, in this ontology, essential. This being the reason why we in this paper do not ask or seek to answer the question of *who is responsible for the drone development in Denmark*? But rather asking *what is happening*? *What do humans and non-humans actors do?*

2.5 Multiplicity

Multiplicity is performativity therefore we find it appropriate to begin by presenting Law & Singelton's description of practice "*Practices are repetitions. The same patterns or more precisely, patterns that are similar recur, and they go on recurring"* (Law & Singelton 2013: 62). To understand multiplicity we draw on the story by John Law and Annemarie Mol (2008) about the Colombian sheep in 2001 during the Foot and Mouth disease breakout. Put simply Law describes how the sick sheep changes as it is enacted in different practices, the veterinary clinical and laboratory practices enact for instance the sick sheep by symptoms whereas the epidemiology practice is differed by enacting the sick sheep via the probabilities of the infection spreading (Law & Mol 2008). As the sick sheep is enacted the disease is actually a different thing in veterinary and epidemiological practice (Law and Singleton, 2014) it changes from symptoms to probability of infection. ''*It is made or done to be different in these different practices. It is a multiple reality"*(Law and Singleton, 2014: 384). ''*Multiplicity is not plurality*" (Law & Mol 2008: 66). There are relations between the various enactments that both exclude and include each other. The epidemiology practice for example depends on and includes the veterinary practice*, "first to build its predictions and second, to confirm its findings"* (Law & Mol 2008: 61).

Multiplicity enable us to discover the drone multiple trough different practices and just as important how the different drone "*realities get related together in practice"* (Law and Singleton, 2014, p. 384).

There exist though apparent colonizing practices "(...) *enacting realities in ways that assume these to be generally, even universally, applicable"* (Singelton & Law 2013: 270). As Law concludes *"Realities and natures in the plural are endlessly being done alongside oneworld imaginaries"* (Law 2015:136). But if realities appear so it is because they are done this way (Law 2009). Committing to a visible singularity hides the possibility that reality might be done differently, "*the presupposition of singularity not only hides the practice that enacts it, but also conceals the possibility that different constellations of practice and their hinterlands might make it possible to enact realities in different ways"* (Law 2004:66).

Multiplicity enables us to ask, how could it be done differently?

2.5.1 Relations within practices

As practices enact realities they enact collateral realities as well (Law 2009). "*Collateral realities are realities that get done incidentally, and along the way. They are realities that get done, for the most part, unintentionally"*(Law 2009:1). As a reality gets framed something collateral is been done, if survey research stages a consumer, it collaterally *"does individuals as quantifiable (actually self-quantifying) respondent's "* (Law 2009:14). When drones are enacted explicitly it is easy to see them and see the collateral realities (Law 2009). In relation to collateral realities, we follow Law (2002) argument, that when a practice enact a reality it enacts relations of absence/presence *"It enacts distributions in the form of an oscillation between absence and presence, and oscillation is one of the conditions of its possibility"*(Law 2002:135) Relation of absence/presence "*embodies and expresses a set of tensions between what is present on the one hand, and what is absent but also present on the other"*(Law 2002:135).

3.0 Research methodology

This section is dedicated to outline how we have approached the object of study by a multi-sited ethnographic design. We have utilized three different ethnographic methods, qualitative interview, participatory observation and desk research.
This chapter elaborates why we have constructed this particular research design and the implications of the methods utilized.

3.1 Tracking strategy: follow the drone

The phenomena of civil drones is a phenomena not only located in one single setting but moves around and is found in various contexts such as the business industry, the universities, the public sector, among politicians etc.
In order to understand the drone development path in Denmark we explore how the drone travels and is part of different practices "*to study how actions become possible through entanglements (Callon, 1986; Latour, 1991)*" (Garud, Kumaraswamy, Karnøe: 2010: 770). We have utilized a tracking strategy of following the concept of a civil drone (Czarniawska: 2014). The tracking strategy is a method for the investigation of multi-sites, as Marcus (1995) argues "*Strategies of quite literally following connections, associations, and putative relationships are thus at the very heart of designing multi-sited ethnographic research"* (97).

3.2 Multi-sited ethnography

Our ethnographic multi-sited research design is inspired by Marcus (1995) who defines the basic assumptions behind this construction as "*Ethnography moves from its conventional single-sited location, contextualized by macro-constructions of a larger social orders, such as the capitalist world system, to multiple sites of observation and participation that cross-cut dichotomies such as the "global", the "lifeworld" and the "system"* (95). By this assumption is understood that nearly everything is more or less mobile and multiple situated, thus not only locally embedded and anchored in a bigger system, but instead the global is more or less locally produced. Assumptions originating from the globalization and the information

age, "*this seemingly chaotic, confusing and complex historical period* (Hylland Eriksen, 2004: 6). To understand this complex world, the drone development must be viewed from both a local and global view, and with critical eyes toward earlier presuppositions (Hylland Eriksen: 2004).

3.3 The actors encountered

The actors we have encountered through the ethnographic methods are chosen on behalf of their engagement with civil drones. They each represent different areas of the Danish drone development field in an attempt to engage a representative group of active actors regarding the drone development in Denmark. We have chosen actors representing the chain of legislation, research, development, usage and interest groups: a trade union and a network organization. The actors were selected in an ongoing process as we gained more familiarity with the field. For example at the UAS Denmark's annual meeting we met The Danish Emergency Agency, a meeting which led to a field trip visiting the agency in Tinglev. We are aware that probably relevant actors have been left out, but as described by Latour (1990) each actor can be a network in itself, presenting an endless research field.

The actors briefly described:

Researchers: *Aalborg University Drone Research Lab*
"*Drone Research Laboratory organizes drone activities at Aalborg University. AAU has been actively involved in teaching and research of drones since 2000*". The lab is led by the engineer Anders la Cour-Harbo who has been working with drones for over 15 years (Aalborg Universitet 2016; interview with Anders la Cour-Harbo).

Drone producer and developer company: *Sky-Watch*
Sky-Watch is founded in 2009 is the only Danish company producing drones and located in Støvring. Sky-Watch does research and development. They work with a professional segment what they call semi-civil customers such as government agencies, the military and

other private companies. They had an ambition to produce drones for international aid agencies but it was not feasible due to the agencies lack of capital.
(Sky-Watch 2016; interview with Michael Messerschmidt, Chief Business Dev. Officer).

Government agency user: *The Danish Emergency Management Agency*
The Danish Emergency Management Agency (DEMA) is an agency under the Danish Ministry of Defence "*The purpose of the Danish civil preparedness is to prevent that major accidents affect life, welfare and environment*" (Beredskabsstyrelsen 2016).
DEMA implemented drones to their work in 2014.
(Field notes from visiting DEMA in Tinglev; interview with Per Teglgaard, Head of section)

Private business user: *Dansk Drone Netværk*
Dansk Drone Netværk is a company using drones for inspections and video recording for the insurance, advertisement and construction industry.
(Dansk Drone Netværk 2016; interview with Ulrik Max Nielsen, owner).

Legislators: *The Danish Ministry of Transport and Building*
The Danish Ministry of Transport and Building is the authority responsible for developing the recently proposed Danish drone legislation and co-producer of reports on civilian drones in Denmark.
(Transport- og Bygningsministeriet 2016; Field notes from UAS Denmark's annual network meeting).

Danish drone network branch organizations: *UAS Denmark*
UAS Denmark is the largest Danish drone branch network organization, founded in 2012 and located in Odense. A lobby organization as described on their homepage: "*UAS Denmark (...) your voice at Christiansborg (Danish parliament). We are constantly working on creating focus on the industry, in which political goodwill and support are essential for future growth. Your input is basis for our political focus and we are in contact with relevant political decision makers*" (UAS Denmark 2016e).
Several of the encountered actors during the research are members of UAS Denmark (Sky-Watch, Aalborg University, Dansk Drone Netværk, IDA and The Danish Emergency Agency).

In total UAS Denmark has 80 members (UAS Denmark 2016a). UAS Denmark held their annual network meeting the 23th of February 2016.
(Field notes from UAS Denmark's annual network meeting)

Engineer trade union: IDA
IDA (The Danish Society of Engineers) is a trade union, with more than 100,000 members, for engineering and science graduates, ensuring the future of Danish engineers (IDA Universe 2016). Drones are an interest at IDA and June the 1.th. 2016 they hosted Nordic Drone Games, an event about and with drones.
(Interview with Tino Rabe Tønnesen, chief consultant at Technological Network, IDA and the event planner of Nordic Drone Games).

3.4 Our role as researcher

In this study we adhere to Law's (2008) notion that 'universalism is dead' and instead multiple realities are being practiced. If multiple realities are being practiced then different methods when doing research does as well"...*enact different versions of the world, its objects, and its subjects*" (Law 2008 p. 13). Multi-sited ethnography concurs as well with the perspective of a 'non-neutral researcher', whom Marcus (1995) defines as the 'circumstantial activist'. Arguably a researcher is not just retrieving knowledge about the world, but also rather engaging with it, affecting it and being affected by it in return. During this process we have worked together with various actors, letting them into our world and in return they have let us into theirs. As we are implicated in the relation created in our study, we therefore consider how our research may contribute to the broader field of implementing and developing new technology.

3.5 Methods: qualitative interview, participatory observation and desk research

To overcome and rethink methods that are enacting one single reality, we consider 'method practices' and multiplicity using various methods, at various sites, rather than one single

method and site (Law 2008). We have done so by methodological triangulation using qualitative interviews with a range of different actors, participatory observations and desk research.

3.5.1 Qualitative interviews

Our qualitative research interview "*attempts to understand the world from the interviewees' views* (and) *unfold the meaning related to their experiences*" (own translation from Danish) (Kvale & Brinkmann 2009, p. 17).

We have interviewed 5 of the previously presented actors:
-Aalborg University Drone Research Lab
-Nordic Drone Race (the engineer union IDA)
-Dansk Drone Netværk
-Danish Emergency Management Agency
-Sky-Watch (drone developer company)

The qualitative research interviews were carried out in three different ways: face- to-face, through a telephone or via Skype. The interview is one of the most common methods when dealing with social science, as it allows a researcher to get an understanding of social processes and how meaning is constructed and articulated by the actors themselves (Czarniawska, 2014). Interview is a good method to generate narratives and to understand practices (Czarniawska, 2014).

3.5.2 Semi-structured approach

To guide the interviews a thematized interview guide was drafted. Utilizing the guide during the interview kept the discussed topics close to the pre-selected themes. This simplifies the later analysis generating some comparability between the different interviews with different actors and reducing off topic information. The advantage of producing a thematized interview guide instead of 'a long list' of specific questions, is that it allows room for spontaneity created in the situation (Kvale & Brinkmann, 2009).

By this semi-structured approach the informant was invited to express him/ her more freely. This enabled some space for their own perspectives and inputs expressed in stories and themes as it felt natural in the situation (Kvale & Brinkmann, 2009). Likewise we as researchers used this space to ask follow up questions when it seemed relevant. As both parts (researchers and informant) exchanged meanings on the basis of a common topic, interesting information and new knowledge were clearly being constructed (Kvale & Brinkmann 2009).

3.5.3 A narrative way

We pursued to construct interview settings where the interviewees could talk freely and in a more narrative way. The way of questioning was done to understand, without pressuring our preconceptions, how actor's different practices unfold and how they perceived a drone. According to (Czarniawska, 2014) "*The eliciting of narratives should be a key element of any interview*" (31). Obviously, by letting the interviewee explain her/him through narratives gave rise to interesting stories from the interviewee including "*aspirations and their memories (Ricoeur, 1984)"* (Garud, Kumaraswamy, Karnøe: 2010: 769).
The interviews seek to cover the present situation, past experiences and future expectations presented through their stories.
In line with Kvale & Brinkmann (2009) we are aware that as we as researchers are the ones constructing the framework and controlling the situation, the power relation distributed between us and the interviewee is never totally equal, but we staged the interviews as casual and comfortable as possible in the given situation.

3.5.4 The interview guide

The interview guide builds upon 5 main questions, which guided the sessions.

1) How would you describe a drone with own words?

This question was asked in order to get an understanding of how different actors perceive a drone, and what associations they add to it. It was a question some interviewees felt little hard to answer in the first place, but with the help of stories from their life they were able to reply, often in a very interesting way. One such story was told by Per Teglgaard from the

Danish Emergency Management Agency about an experience in Fredericia when a oil tank was on fire. He explained how the drone was useful as a leadership assistant tool in this situation, why a drone to him is a leadership assistant tool.

2) What are your future perceptions and expectations for your work with drones? (and your expectations of drones in Denmark generally?)
3) What conditions and expectations have been taken into account by the usages of drones in your work? (What are the essential risks of drones?)
4) How are drones more concrete being utilized?

These three questions were asked to understand how various actors relate to drones in their context. The questions were a way to investigate and discover practices. As we adhere to the notion that drones are performed by practices we aimed to get an insight to the practices the actors engage in, as we did not have the resources to personally visit them all. Actors successfully elaborated interesting and specific stories about their work with drones, including concerns and expectations.

5) How do you (or do you) feel that you influence the development of drones in Denmark? - And have you participated in the hearing about the development of the forthcoming drone legislation?

This question was aimed at revealing how different actors are related, and how to place the actors in the drone development landscape.

All interviews have been recorded, and parts of the interviews have been transcribed. Working with the methods of condensing the interviews, we have made summaries containing interesting and relevant parts of the interviews. However the one with DEMA was not recorded as the interview took place over several hours, when visiting the Danish Emergency Management Agency, field notes were made instead.
We have interviewed Anders la Cour- Harbo fra AAU Drone Research Lab twice and the first time was recorded as it was through Skype. The first interview with la Cour- Harbo was

recorded, the other interview took place at the Drone Research Lab in Aalborg when visiting la Cour- Harbo and was not recorded as it took place while we got a guided tour in the lab.

3.5.5 Participatory observations

We have visited the DEMA in Tinglev, a facility where they educate incident commanders and drone operators and AAU Drone Research Lab in Aalborg, a laboratory where they are doing research on drones. We have participated in UAS Denmark's annual drone meeting held at the headquarter of the engineer union IDA, a meeting for the drone industry, enthusiasts and politicians.

These places were chosen because they are some of the nodes where a lot of drone activities are carried out. Participant observation "*draw attention to the fact that the participant observer/ ethnographer immerses him- or herself in a group for an extended period of time, observing behavior, listening to what is said in conversations both between others and with the fieldworker and asking questions*" (Bryman 2012: 432).

Observations gave us the chance to discover how different actors enact drones in situated practices. At DEMA we got the opportunity to discover how they work with drones when an emergency scenarios occurs. At AAU Drone Research Lab we got a guided tour in the lab where we observed how drone research is done. At the annual UAS Denmark drone meeting several actors were represented which gave us the ability to observe the interplay between various practices, how actors are negotiating opinions and how different concerns and expectations are addressed. The different observations were recorded on field notes.

The combination of a method of observing what is taking place, some would say "*actual behavior* " (own translation from Danish) (Kvale & Brinkmann 2009, p. 136) and a method of listening to what a person is telling "*implicit perceptions and tacit understandings*" (own translation from Danish) (Kvale & Brinkmann 2009, p. 136) have shown to be a very fruitful combination for doing empirical research.

Our observations were not structured beforehand, as we wanted to observe what felt natural in the situation, which was difficult to plan in advance (Czarniawska 2014).

At DEMA we did not know what to expect in advance but were surprised by their hospitality and engagement. The agency took us to a training session that gave us a deep insight in

their practice. Without this experience we would never had been able to comprehend what 'actually' is at stake.

3.5.6 Desk research

To be able to navigate in this rather chaotic actuality of civilian drones, desk research was carried out in the initial phase in order to get an insight to the technology, the actors engaging in the field and the history of the drone development.
Desk research helped us retrieve important information, especially concerning the drone legislative proposal and the process behind the proposal, as most documents are accessible to the public.
Documents were being compared with the observations and interviews. Hence the documents were applied in order to support generated data from the field. But not only were they applied in a supportive manner, they have as well been actively involved in the analysis and discussion part. Especially do we draw upon the reports of 'Civil Drones in Denmark' (Fonden Teknologirådet 2014) 'The Future Regulation of Civil Drones' (Trafikstyrelsen 2015) 'Mapping out Drones in Denmark' (Teknologisk Institut 2016) (Own translation of titles from Danish).

3.5.7 Digital methods

Scopus
Scopus is the largest abstract and citation database of peer-reviewed literature (Scopus 2016). Extracted data from Scopus can be manipulated and can give a quantitative impression of literature concerning drones. The keywords drones, uav or uas were applied, and searched for in title, abstract and keywords of the literature papers. The results from Scopus appear in the analysis (see Actors interconnected; Discovering the singularity push).

Google Trends
Google Trends reveals how often, and to what extend certain words and related terms have been searched for in Google (Google Trends 2016). Investigating the search term *UAV*

(unmanned aerial vehicle) in Google Trends provides quantitative results of searches for UAV and related terms, such as *drones*. This gave us an impression of how the interests and awareness of drones have changed over time. The results from Google Trends, in the form of a graph, appear in the analysis (see Actors interconnected).

Drawing maps

Maps were drawn in the program Lucidchart (2016) and Gephi (Gephi 2016) during the project to support our research, analysis and visualize complex structures. For example in the initial phase of the research we made up a map illustrating various fields drones are applied, in order to get an overview and in order select the actors encountered. The map was drawn in Lucidchart (2016), based on retrieved publications and news media.

Lucidchart was as well applied for drawing a map illustrating the design of the theoretical aspects of the project. The map was used as an inspiration for structuring and approaching the analysis.

After getting a deeper understanding of the actors engaging in the field, during our analysis, we produced a map in Gephi (Gephi 2016) of actor involvement in 3 Danish produced reports (see 'Actors interconnected').

3.5.8 Analyzing the field material

We have endeavored to let the empirical data 'speak for itself' by avoiding letting our hypotheses control the treatment of the data. We did have themes when doing interviews, in the form of our interview guide, but we have not attempted to let those themes control the empirical data.

To cope with the great amount of data, condensations of the empirical material were carried out as first step of processing the data (Kvale & Brinkmann 2009).

Afterwards themes were selected. This was done by comparing the various condensations to look for similarities and differences between the various statements and narratives, how they exclude and include each other (Czarniawska 2014). Content from relevant publications were used as inspiration for making up themes, such as the drone legislation and terms of

safety, security and privacy, which are present concerns (Trafikstyrelsen 2015; Transport- og Bygningsministeriet 2016; Fonden Teknologirådet 2014).
The themes can be seen in the form of a drafted excel document, which gives a quick overview of how the different actors relate to different themes.
After the thematization, subthemes were being extracted, and connections between the themes and actors were made, inspired by the method of affinity diagram (Bødker, Kensing & Simonsen 2008). This method created structure and overview of the data.
The analysis has been an iterative process, going back and forth between the empirical data, literature, the drawn maps and the analysis. After each iteration we gained a deeper understanding of the material.

3.5.9 The structure of the analysis

The following chapters of the analysis and discussion are presented as the temporal conception of a path. The path of *the historical*, *the actual* and *the future.* The analysis begins with a historical review of important event in in Denmark relating to the drone development. It then moves into the *actual*, exploring practices and relations between actors. Finally we address the future in the discussion presenting stories about how it *could be different.*
The analysis is constructed by applying different perspectives on the development path. The perspectives should not be understood as separate but as methods to zoom in and out of the material. This technique has enabled us to discover 'local' practices as well as connections between practices. A technique for discovering the drone development path, its actors and practices. We apply the analytical tool of multiplicity, presenting the tension between present, absent and between colonizing practices and subordinate practices.

4.0 Analysis

4.1 Historical review

We begin our analysis with a historical review of key events that affected the creation of the drone development path, highlighting how the drone landscape steadily has emerged. The drone development path we observe today did not suddenly come into existence, but is created by combination of events and actors that ongoing came into play.
The historical review serves as a framing of the path creation and lays the groundwork for the later analysis. It is based on publications and news articles traced by desk research and interviews with our informants.

4.1.1 The drone began in the military and as model planes

What we interpret as drones nowadays appear for the first time in use during the First World War (Braun, Friedewald & Valkenburg 2015). The drones at that time were not the technological sophisticated machines we know today (Img. 4.01). According to The House of Lords' European Union Committee (2015) the first recorded use of drones was when England used drones in 1935 as target practices*"*(...) *when the Royal Navy used the DH82 Queen Bee for target practices"*(9).

Img. 4.01 Photographs of de Havilland Queen Bee K4227 Photos: Royal Air Force (Vintage Wings of Canada 2016).

The last couple of decades have seen the development of more sophisticated drones, especially from the United States of America's military, for reconnaissance and operational purposes and these, "*such as the Global Hawk and Predator, have commonly been referred to as 'drones'"* (House of Lords 2015: 9). Model planes or small radio-controlled model aircrafts have been flown for decades for leisure. The first appearance in Denmark of this practice was around the 1920's and today there are approximately 3600 members in over 100 Danish model-flying associations (Den Store Danske 2016)
Drones can thus predominantly be traced back to a military context and model aircraft and it was not until recently the concept of a drone 'moved' into other contexts as the civilian one- the civil drone.

4.1.2 Timeline of selected major events in the creation of the drone development path

We chose to begin the timeline with the founding of the first Danish drone producing company in 2009, this is not to insinuate that other important events or actors have not been present beforehand.

2009: The drone producer company Sky-Watch is founded
The company began as a collaboration between different industrialists and entrepreneurs in Northern Jutland.
(Sky-Watch 2016).

2010: Odense Airport (today Hans Christian Andersen Airport) is launching a long-term drone strategy
Odense Airport, today HCA Airport, is in economic difficulties. The owners, the municipalities of Odense and Nordfyn, initiate a new growth strategy in 2010 to avoid the risk of closing the airport. The strategy includes the establishment of a leading European drone testcenter at the airport (Odense Lufthavn 2010).

2011: A Danish drone test center is being established
In accordance to their strategy from 2010, HCA Airport begins the establishment of a

national test center for drones, by the name UAS Test Center Denmark. The goal is to make it into the leading cluster for drone technology in Europe. It is supported by the Danish Transport and Construction Authority (UAS Test Center 2016).

2012: The drone network branch association UAS Denmark is founded

As part of HCA Airport's long-term development strategy, formed in 2010, the drone network branch association UAS Denmark is founded. UAS Denmark is located at the airport (UAS Denmark 2016).

2013: The second drone producing company, Little Smart Things, is founded

Little Smart Things is founded in 2013, shortly after the founder and CEO is awarded Entrepreneur Of The Year 2014. The company is located on the island of Bornholm (Little Smart Things 2015).

2013: The Danish government establishes a cross-ministerial workgroup tasked with assessing the need for a more contemporary regulation of the drone field

The government acknowledges the growing industry and popularity of drones and initiates a workgroup to research if the current regulation is sufficient (Schmidt 2015b).

2013: (October): The Danish government agrees on distribution of research reserves in 2014 should include mapping and technology assessment of ongoing and planned civilian actors' usages of drones in Denmark

The government dedicates funding to further research in drones. This is another sign that drones are on the government's agenda (Uddannelses- og Forskningsministeriet 2013).

2013: (July): The concept of a toy drone for private use is becoming widespread, as portrayed in Danish medias, such as Politiken

Drones are now widely available for the general public for purchase, the growing interest is ascribed to better and cheaper cameras and batteries (Korsgaard & Rothenborg 2013).

2014: The Danish Emergency Management Agency (DEMA) implements drones in their work

DEMA establishes a strategy for purchase and usage of drones for assisting in complicated emergencies at a national and international level (Beredskabsstyrelsen 2014; 2016).

2014: (March) The Ministry of Transport and Building publishes AIC B 08/14 Business use of UAS/RPAS in Denmark

Because of many inquiries from businesses to get dispensations, required if flying a drone 150 m from a building or public road, The Ministry of Transport and Building publishes AIC B 08/14 that lists requirements for seeking dispensation. This is an addition to the existing law BL 9-4 for drones under 25 kg. Beforehand there were only written that *dispensation can be obtained in very special instances* (Trafikstyrelsen 2014).

2014: (July) The Danish Board of Technology Foundation publishes their report investigating civil drones in Denmark

The first major report about civil drones in Denmark. This publication is a collaboration between The Danish Board of Technology Foundation, universities including the head of department for AAU Drone Research Lab, organizations including UAS Denmark, Ethical Council and a governmental agency as observer (Fonden Teknologirådet 2014).

2014: (August) The European Union publishes two notifications on drones

European Commission publishes two communications, 'A New Era for Aviation' and 'European Commission calls for tough standards to regulate civil drones', that influence the Danish development path (European Commission 2014a,b).

2015: (March): The Danish Transport and Construction Authority publishes a report made by the cross-ministerial working group in which recommendations for a comprehensive regulatory framework for civil drones is presented

The working group established in 2013 publishes their results. This is a proposal for a modern regulation of drones. It calls for a drone license and includes a recommendation for a dispensation of drones below 250g (Trafikstyrelsen 2015).

2015: Oxford Research publishes a report on the job potential with drones in Denmark, by analyzing the potential of a test center.

This report commissioned by UAS Test Center Denmark. Oxford Research concludes that a drone test center could potentially be the mean for Denmark to be a frontrunner in drone development. They predict as well that if Denmark becomes a leading country in drone development 15,000 jobs could potentially be created in the industry (Oxford Research 2015).

2015: (April) the University of Southern Denmark (SDU) opens the first drone specific master's program in Europe, it is a two-year master program for engineers, specializing in drone technology

SDU works closely with HCA airport and the UAS Test Center Denmark, as they are located in the same area (Syddansk Universitet 2016).

2015: (July): UAS Test Center Denmark is now in charge of processing applications for authorizing drone operators.

Drone operator applications were previously processed at the Danish Transport and Construction Authority using the AIC B 08/14 regulations.
As an increasing number of operators are inquiring for dispensation the task is delegated to UAS Test Center Denmark (Trafik-og Byggestyrelsen 2016).

2015: (November): The drone developer and drone producer company Little Smart Things declares bankruptcy

Little Smart Things declares bankruptcy and gets bought by the drone producer Sky-Watch. Sky-Watch at Bornholm will continue to work primarily with the production and development of the traditional fixed-wing aircraft. Sky-Watch in Støvring will deal with multirotor drones. Sky-Watch is now the only drone producing company in Denmark (UAS Denmark 2016d).

2015: (October) Aalborg University (AAU) Drone Research Lab is established

AAU has been actively involved in teaching and research of drones since 2000. The research lab is established in 2015 showing that drones begin to be a significant discipline. Drone Research Lab is an university laboratory that consolidates drone research at AAU (Aalborg Universitet 2015).

2015: (December, 16th) The Minister of Transport and Building, Hans Christian Schmidt, proclaims that Denmark must be a leading country in the drone field

In relation to the new drone regulation, still in the making, he states that Denmark must be leading country in the drone field (Schmidt 2015a).

2016: (February, 24th) The recommendations of a new drone law are presented in a legislative proposal, by the Minister of Transport and Building

The legislative proposal is sent to review and consultation with relevant stakeholders (Folketinget 2016a).

2016 (February) Drones@AAU begins to be established, an interest network for researchers and companies

The aim of Drones@AAU is to enable researchers and businesses to meet, share knowledge and work together **(**Aalborg Universitet 2015).

2016: (March) The Technological Institute is publishing their report on mapping civilian drones in Denmark

Teknologisk Institut is publishing an investigation of businesses using drones and in what areas. The report shows that there are 294 businesses in Denmark that have registered at least one drone (Teknologisk Institut 2016).

2016: (May, 31th.) The Danish parliament passes the new drone legislation

The new law does not include the threshold limit on 250 grams, which was included in the initial proposal. The abolition of the 250g-threshold limit adheres to the industries recommendation of stricter regulation for private use and the outspoken worries in the Danish parliament for privacy, as small drones can have a camera. As shown by the graph (Fig 4.02) no parties of the parliament voted against the law proposal, however 9% were abstentions, which was the leftwing party Enhedslisten (EL) (Folketinget 2016b)

The new law includes:

-The law allows in general drone flights in more areas. It moved from a previous weight based approach to a new risk management restriction.

-For private use a special drone license is now required (before there were no requirements for demonstrating skill or knowledge of drone use for private users).
-For business operators a license is required as well, it replaces the previous special permission, however with greater demands than the one for private use.
-The previous special permission was bound to the company acquiring it, the new license is personal (Folketinget 2016a; McGhie 2016a)

Fig. 4.02 *The total vote result of the drone law in the Danish parliament may 31th 2016. F: pro I: against U: abstentions O: absent* (Folketinget 2016b).

2016: (June) The drone event Nordic Drone Games is taking place

The first Nordic Drone Games is held at the UAS Test Center Denmark. This event includes demonstration of drones and competitions. Held by the engineering union IDA (Simonsen 2016).

2016: It is announced that the international sport channel ESPN will start broadcasting drone races live on TV

ESPN and the International Drone Racing Association (IDRA) enter into a partnership to broadcast drone racing live on TV starting in August 2016. Drone races are the most widespread and popular sport with drones (IDRA & ESPN 2016).

4.1.3 What does a timeline reveal about the development path creation?

The timeline places drones in their historical setting, this helps comprehend that the drone development path is not something that suddenly came in to be, but an evolution.

Examining the timeline we observe how actors manifest themselves in important events. Producers, regulators and research institutions are introduced and disappear again, as little Smart Things' bankruptcy. The drone becomes increasingly institutionalized in interest and industry networks of UAS Denmark, Drones@AAU, the government in the form of regulation, education and research institutions as AAU and SDU. Powerful inscriptions are simultaneously produced that attempt to frame the development path as recommendations, regulation or analysis. The inscriptions appear as loyal allies if we considered how communication from the European Union became part of the Danish development path reiterated in various reports.

Observing the timeline, it appears that continuously more actors came into play as the interest for drones is growing. It was not by chance it was chosen that the timeline should begin in 2009, extracting data from Scopus, the largest abstract and citation database of peer-reviewed literature, we can observe that since 2010 there is an almost exponential growth of articles concerning *drones* (Img 4.03).

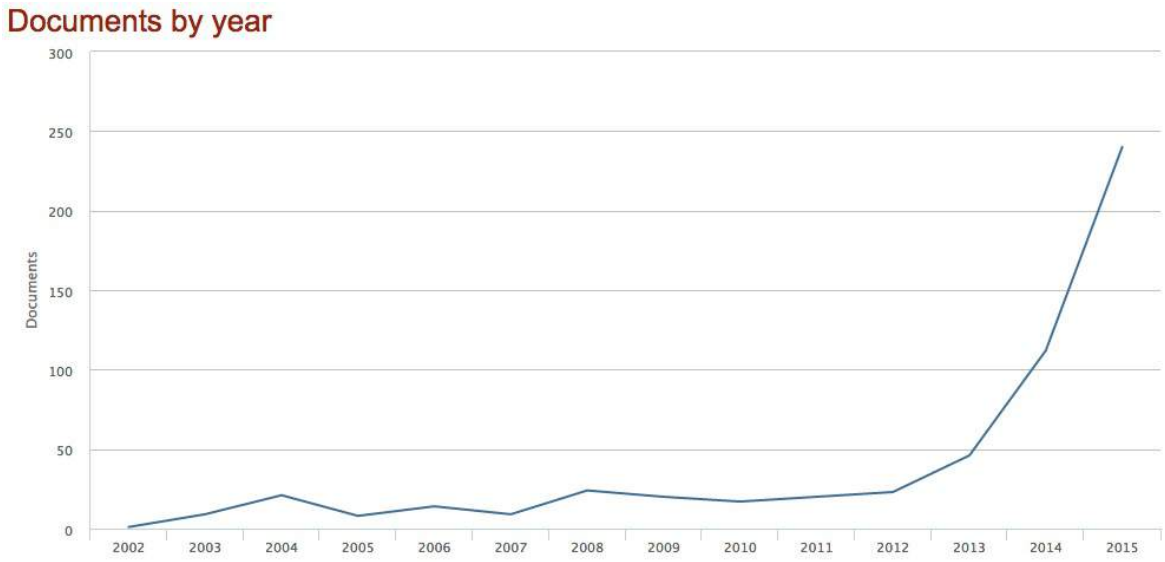


Fig 4.03 Graph of peer-reviewed literature produced in Scopus. The keywords drone, uav or uas are applied, and searched for in title, abstract and keywords of the literature papers.

The same hold true by popular search terms. Applying the search word *UAV (unmanned aerial vehicle)* into Google Trends it is revealed how searches for drones in Denmark have been steadily growing since 2009. The spikes in search interest, most obvious in 2014-2015 happen around November and December. This could indicate an interest in drones as a

Christmas gift, as journalists write in news articles from Metroxpress (Stougaard 2014) and DR (Ellesøe 2015).

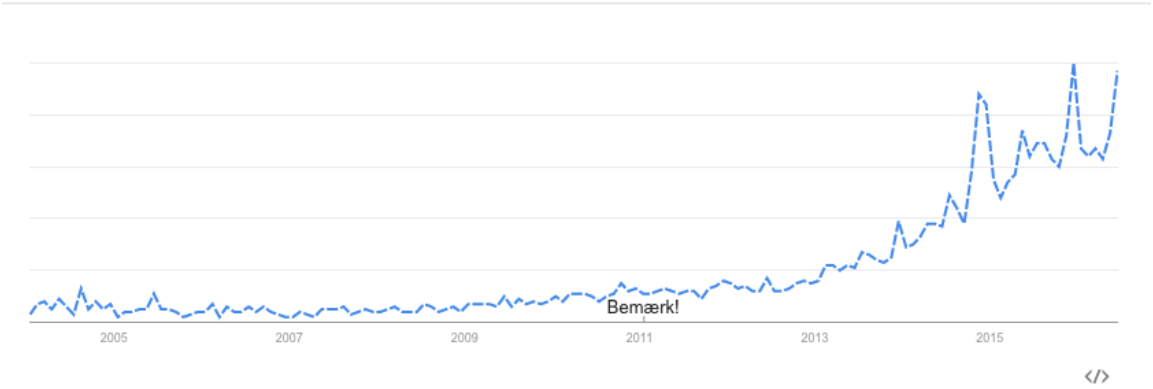


Fig 4.04 Graph of results of searches for UAV and related terms, such as drone in Google, from 2009-2016.

As much was revealed in the timeline, it does not reveal how actors are linked with each other. The timeline only shows a flow of events and actors, seemly independent from each other, more or less casually becoming part of the drone development path. Unless one looks closely and sees actors appear in multiple events, the timeline hides the interconnection between actors. Because the timeline hides the interconnection between actors it makes the path appear serendipitous. We are left with the question of, how are these actors connected?

4.2 Actors interconnected

To better understand how the actors are interconnected we initially analyze their relation through mapping their involvement in the three major Danish reports that have been mention in the timeline. We find the reports quite suiting to gain an impression of relations between actors, as the actors involved can easily be found as their role as author, co-author or reference.

To further explore their interconnectedness we present, through small stories, their relations based on our interviews and desk research.

4.2.1 Map of actors involved in the three major Danish publications

As shown throughout the timeline several actors seem to participate in the development of drones. In particular three influential reports about civilian drones in Denmark appear in the timeline. The reports are 'Civilian Drones in Denmark' (Fonden Teknologirådet 2014) The Future Regulation of Civilian Drones' (Trafikstyrelsen 2015) 'Mapping out Drones in Denmark' (Teknologisk Institut 2016) (Own translation of titles from Danish). We have mapped actors involved and their relation to these three reports in the form of author, co-author or reference:

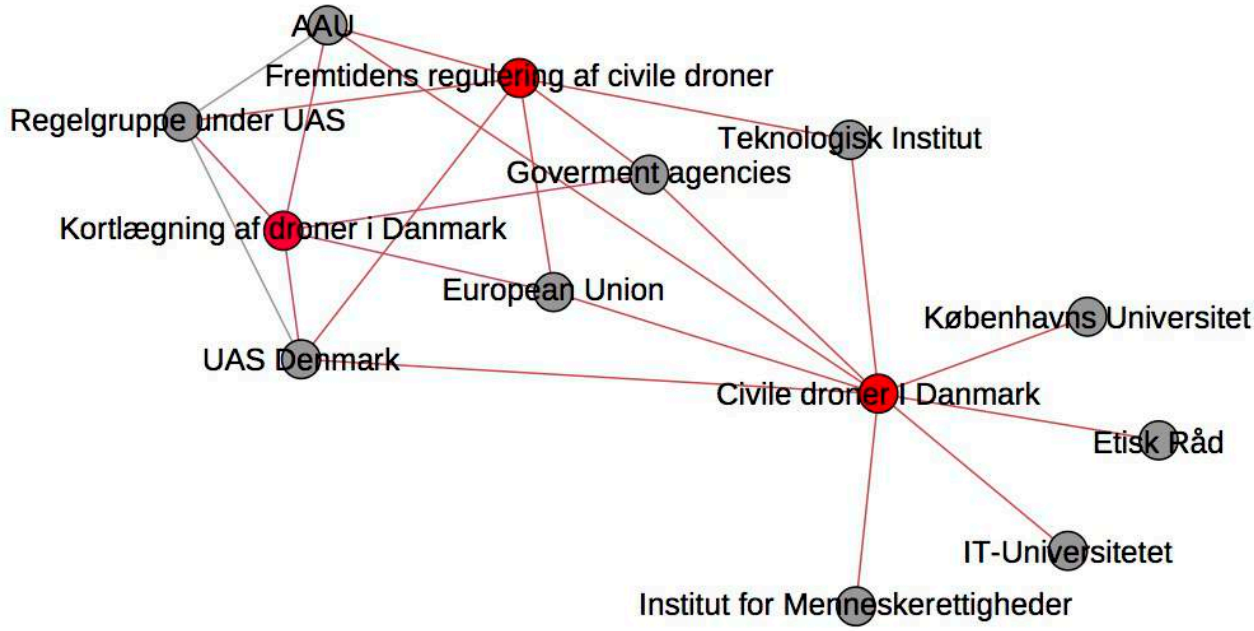


Fig. 4.05 Map of actor's involvement in three reports[1].

The red nodes are the reports. The edges represent connection either as author, co-author or reference. The European Union node is comprised of to papers, which are referred to by the various reports.

[1] The 3 reports are:

-Fonden Teknologirådet 2014 'Civile droner I Danmark'
-Trafikstyrelsen 2015 'Fremtidens regulering af civile droner'
-Teknologisk Institut 2016 'Kortlægning af droner i Danmark'

The map is very interconnected with most actors having more than one relation to the reports. The number of actors involved is limited and composed of institutions, or individuals representing an institution. The map reveals that inscriptions produced from the European Union are incorporated and referred to in these reports. This suggests that there is a relation between the Danish and the European Union drone development, and that that the European Union is used as ally to the Danish technological path.
We observe that AAU, UAS Denmark and the Regelgruppe, (a 'regulation' workgroup of UAS Denmark, where AAU is participating as well (UAS Denmark 2016d) are central actors.
The report 'Civile droner i Danmark' by The Danish Board of Technology Foundation from 2014 is referred to by the 2 other Danish report. The Danish Board of Technology Foundation's (2014) publication is the first of the 3 reports to be published. It seems thus that the inscriptions produced by the first report are incorporated in later reported liking them somewhat together.
One concrete example on how they refer to each other can be found in the publication from the Danish Transport and Construction Agency (Trafikstyrelsen 2015) where there is a reference to an estimate provided by the branch organization UAS Denmark, saying that toward 2017 the drone industry will create 750 jobs in Denmark. The Danish Transport and Construction Agency does not refer directly to UAS Denmark, but to The Danish Board of Technology Foundation's (2014) report re-referring to UAS Denmark's estimate.
This example shows how inscriptions being produced by an actor, in this case UAS Denmark, travels to the other reports. In general we discover several inscriptions in the other two publications, which can be traced back to The Danish Board of Technology Foundation's report and are used as loyal allies, increasing the authority of the inscriptions as they are reproduced.

4.2.2 Stories about the interconnectedness of the actors

As presented in the timeline, a test center was established in 2011 and the branch organization UAS Denmark was founded in 2012 as a part of HCA Airport's growth strategy in 2010. UAS Denmark is an institution that has 80 members today, mostly from the business industry and universities. Both actors, the test center and the branch organization,

are located at the airport in Odense, and cooperate with each other. The test center is supported by the Danish Transport and Construction Authority. In Odense is located the Southern Denmark University (SDU). The university does research on drones and it cooperating with the test center and UAS Denmark. UAS Denmark has set up the Regelgruppe, as previously mentioned (UAS Denmark 2016d). Represented in this group are Aalborg University (in the form of Anders la-cour Harbo, The leader of AAU Drone Research Lab), SDU and the drone producer company Sky-Watch.

This group has contributed to a threshold limit of 250g for drones, which figures in in the law proposal from 2015, published by The Danish Transport and Construction Agency (Trafikstyrelsen 2015).

We identify that many drone activities are taking place and actors are located in the area of Odense, why Odense could be classified as a node of drone activities in Denmark. The test center seems to have worked as catalyst for the creation of the node, as a lot of the activities can be traced back to the test center and HCA Airport. The testcenter cannot be considered alone though, as it is part of a municipal strategy to save the airport and arguably SDU, which at the time of the test centers creation had a renowned robotic department (Syddansk Universitet 2016), contributed to the testcenter creation and development.

The head of Drone Research Lab at Aalborg Universitet Anders la Cour-Harbo, who is part of UAS Denmark's Regelgruppe, explains that the drone testcenter pushed the research on drones, as this center enabled interested actors, from small enthusiasts to the larger commercial drone producers, to physically tests their drones (Interview with la Cour-Harbo). la Cour-Harbo states as well that the network branch association USA Denmark played a major role in lobbying the politicians to have a civilian drone agenda, proposing drones as beneficial for the Danish business industry. la Cour-Harbo explains that it took quite an effort to convince the politicians that drones would be beneficial for Denmark and to get drones on the political agenda. It would seem that UAS Denmark's lobbyism succeeded, as 1 year after the establishment of UAS Denmark the government initiated a cross-ministerial workgroup to assess the need for a more contemporary drone regulation. In 2016 recommendations for a new drone law were presented in a legislative proposal by the Minister of Transport and Building and the law passed in parliament on May 2016.

UAS Denmark played an influential role, however, drone activities started to take place

before the UAS Denmark was created, as pointed to by la Cour-Harbo. For example the drone producer of Sky-Watch was founded in 2009, years before the establishment of UAS Denmark, a company that began as a collaboration between different industrialists and entrepreneurs in Northern Jutland, Denmark.

The program of 'drone development in Denmark'

It appears that the actors, who are linked in Odense and through the reports, together push a *program*[2] (Latour's 1990) of 'drone development in Denmark'. The program works toward getting drones on the political agenda, working with, in the beginning, unresponsive politicians. As la Cour-Harbo explains, it took effort to convince politicians that drones in Denmark can have a major potential and should be 'cultivated' by a new and more contemporary legislation. The unresponsive politicians can thus be considered as adhering to an *anti-program* (Latour 1990).

The program of 'drone development in Denmark' seems pushed by association of the institutionalization of UAS Denmark an actor gathering many other actors including universities, researchers and the industry, the production of inscriptions in the form of publications and the gathering of powerful allies such as the European Union.

This program ends up being successful, as in 2015 The Minister of Transport and Building presents a new legislative proposal for usage of drones, and more funding for drone research is given. The recent statement of the Minister of Transport and Building; that Denmark must be a leading country in the drone field, illustrates well that the government is now an ally to the program. It is clear that the drone agenda was not an initiative from the politicians themselves, but rather something that sprouted from niche areas, like it often is the case with technological developments (Simmie: 2011). What seems clear too is that UAS Denmark managed to establish themselves as a strong actor because of many allies, hence came to have status of a spokesperson for the whole community, pushing the program of 'drone development in Denmark' further.

4.2.3What does the connections between actors reveal about the development path creation?

[2] Taking inspiration from Latour' (1990) *program* and *anti-program*.

Analyzing the connections between actors it appears that just a limited number of interconnected actors are perceptually dominating a development path creation. These actors are predominantly institutions such as UAS Denmark and Aalborg University. We observe the actors, mainly UAS Denmark, promoting a program of "drone development in Denmark". The program developed by association of the institutionalization of UAS Denmark, the production of inscriptions in the form of publications and the gathering of allies such as the European Union. The program managed to mobilize politicians and policy, producing the latest legislation, another powerful allies for the program.
When analyzing connections between actors there appear to be an assembly of actors more or less attached to the program of "drone development in Denmark", maintained and developed by an accumulation of inscriptions, institutionalization and alliances. Less powerful interconnected actors tend to be left out when we analyze links between actors and this analysis does not reveal much of what actors actually do. To further understand what is happening in the development path creation we ask, what actors do? Hence what is 'their' practice, how is the drone enacted?

4.3 Multiple enactments of drones

Applying a multiplicity-oriented ANT perspective allows us to investigate this multiplicity of drones enacted by different actors in various practices. Furthermore, our multi-sited ethnographic approach makes us follow the drone enacted in various contexts. This enables us to investigate what our actors do, what is their practice. Practices enacting drones could be endless as it is equally complex the closer or the further you look. Therefore only a selection of practices will be presented in this paper as 'simplified' descriptions, revealing just a fractal image. Taking inspiration from Law and Mol's (2001) paper *The Actor-Enacted: Cumbrian Sheep in 2001*, in which they study agency of animals in the context of foot-and-mouth disease in the UK in 2001, we analyze the drone enacted differently by different practices, and how enactments have relational links.
We begin by introducing the practices we encountered at the Drone Research Lab at Aalborg University in Aalborg, and The Danish Emergency Management Agency (DEMA) in Tinglev.
These are more detailed described as they include our personal observations in the field.

After this analysis part follows the second part where other practices are presented, these are less detailed as they are based on interviews and desk research and do not include observations as they were not personally visited. Finally the relations between the various versions of the drone enacted are explored.

4.3.1The engineering drone

We begin by investigating the enactment of what we have named the *engineering drone*, which we discover at AAU Drone Research Lab and Sky-Watch, as these practices are concerned with design, building, components, machines, and structures. Visiting Aalborg University's Drone Research Lab we discover how a drone is enacted as a matter of technical elements, and how the work creates scientific inscriptions. The researchers and students working at the lab are predominantly affiliated with the field of engineers. A culture dominated by natural science ideas (Schein 1996). In the lab we encounter an existing socio-material practice involving laboratories, sensors, hardware, software, numbers, calculations, tests, measuring equipment and scientific papers. Experiments are carried out, and essays on the results are being produced. At the laboratory the technical black box of a drone is opened up. The researchers and students interest lies in enabling drones to fly in specific situations, with the aim of solving certain tasks in a safe and effective way for the drone, for properties, and for human beings.
We have interviewed engineer and leader of the lab Anders la Cour-Harbo who gave and us a guided tour in the lab. However, we visited the lab after 'closing hour' thus no students and researchers, other than la Cour-Harbo, were present and no activities as such were going on.
la Cour-Harbo explains how a drone is perceived as a technical platform which can be tied to certain features and tested in the lab. He summarizes the labs work as following

> "*(...) flying around things might be interesting. Or to fly very precisely when flying indoor at a production company - you have to fly quite precisely- how to do that? What to do if things fail, in the drone for example. How do you make it continue to fly if the GPS stops working, the one rudder is out of order or the software is doing*

> *strange things- how do you ensure it keeps flying? So that is the kind of challenges we are working with"* (26:51).

They do research on how drones can be optimized for certain tasks and how new features for drones can be developed. But at the university lab they do not build complete drones, as the technology of building a drone is already developed by international (and one Danish) companies, and therefore is not an interesting research topic for the lab. We discover that enacting the engineering drone requires certain technological elements to be tied together in certain ways. To use the definition from the Danish Board of Technology Foundation it can be summarized as, "*By the term of UAS a drone is understood as a converging technology, i.e., composed by several technologies. The drone can thus be understood as a multi-system in which multiple devices are gathered at one platform*" (own translation from Danish) (Fonden Teknologirådet 2014: 14).

How the lab is organized

The lab is constituted of three rooms, we name them: the students' room, the test room, and the control room.

We first enter the students' room, a large room with tables, wires, unfinished projects, components, computers and other laboratory equipment. The various objects are indicating how students here do prepare experiments and build up various technological objects.

Pic 4.06 The students room with its laboratory equipment

The second room is the test room. In this room drones are experimented on by testing them in simulated real-world scenarios. For the moment students and researchers are practicing how to fly a drone indoor, by the help of different orientation sensors on the walls of the room, as GPS, which is commonly used outdoor for this task, does not work indoor (*Pic 4.06*). This project is done in cooperation with the Danish drone developer company Sky-Watch. The project, commissioned by some large private companies, seeks to understand how to enable a drone to fly indoor in production facilities. The purpose of the project is to enable drones to transport components inside of a production line or warehouse, a task now done by regular employees. Sky-Watch has build a drone that is 40 cm. in diameter utilized for this purpose. In the test room of the AAU lab we locate different equipment, such as a fan utilized for simulating wind, with the aim of testing different kinds of wind environments and monitoring equipment to gain data on the drones behavior. The room has a glass window into the control room. In the test room interference is excluded, and the window serves as a protection and insight for researchers in the control room in order to safely and without interference monitor the experiment.

Pic. 4.07 The test room. Sensors are attached to the wall utilized
for indoor flying experiments. A glass window is separating the test room and the control room.

In the third room, the control room, we find computers, software, hardware, a blackboard with calculations and a collection of a variety of drones. Some drones are big, some small, some with batteries, some petrol powered, some are fixed wings and other has propellers. The drones are stripped of the plastic skin we normally see them with, which exhibits all their internal components. In this room simulations and calculations are done as well as modifications to the drones hardware and software before the drones are experimented in the test room.

Pic. 4.08 The control room: The drones in the lab are stripped away from the plastic skin we normally see them wearing.

Pic. 4.09 The picture illustrates how the drones' internal components are literally kept in a 'black box'- (a curious materialization of Latour's 1990 metaphor of 'opening the black box')

The control room and test room works close together, and the combination make it possible to let experiments and computer simulations support each other.

Work on safety

The lab has currently projects working on potential damage a drone can inflict on a human being. Initially the project was a theoretical calculation for defining the maximum mass for a drone that could not inflict significant harm. la Cour-Harbo explains

> "(...) *the 250 grams I have recommended, they are based on a calculation where you calculate that if it flies so much and with this speed, and hits so hard and so on. If you get hit at the chest then what is the probability that you will die from it?, and how much will be damaged in the body? And all these things will be taken in for an assessment*" (interview with la Cour-Harbo 12:43).

The 250 gram became an important threshold limit in shaping the forthcoming law, it was included in the first law proposal as a limit for the requirement of a drone license, but was not included in the final law. It is important to note, as la Cour-Harbo emphasizes, the universities and the industry doing research do not have the final word when it comes to shaping the legislation, which is the job of politicians. But since politicians unlikely know

much about drone technology they need to ally with knowledgeable experts like la Cour-Harbo. la Cour-Harbo elaborates how politicians have asked for his advice in various contexts.

The research lab continues the work on assessing the possible damage that drones can inflict. They have constructed an apparatus where different components of drones can be isolated and tested in controlled and consistent scenarios. The apparatus is composed of a sort of catapult where a component of a drone or an entered drone can be attached and shot at a precise and consistent speed into an object, often a piece of pork meat *(Pic 4.10)*.

Pic. 4.10 In AAU lab they have developed a catapult where different components of drones can be isolated and tested (Selliken 2016)

The impacted object or piece of meat can afterward be analyzed and the damage inflicted assessed. This kind of research is valuable for politicians and policymakers as it produces inscriptions of seemingly impartial results, which are easily translated to recommendation of desired threshold limits or other regulation. Drone producers, such as Sky-Watch can likewise utilize the assessments in their choice of materials and design.

Isolating the technology externalizing subjective concerns

At the AAU Drone Research Lab the focus of interest is not on the more 'subjective' concerns such as privacy, but on what is measurable and reproducible. la Cour-Harbo elaborates:

> "*Such things as privacy is not something I do have a special opinion about, well that is something others must deal with, and things like what kind of education drone*

> *pilots must have in order to fly with a camera and take pictures of houses. But I do have an opinion about what the drone is able to do. But how to educate people, which is as well a part of the legislation, I do not have an opinion about either*" (interview with la Cour-Harbo 01:42).

The practice at the lab works on the drone as a technological artifact, isolated from social bias, and other interference, tested in fully controlled environments. Michael Messerschmidt, Chief Business Dev. Officer at Sky-Watch elaborates how they do not have a particular focus on privacy and the public either, as they consider others to be more competent in this area, such as politicians, Danish Technological Institute and the Ethical Council. As Messerschmidt argues ''*We are just a producer*" (Interview with Messerschmidt 15:06). This is in concurrence with Braun et al (2015) findings that ''(...) *the externalisation of privacy issues appears clearly as an institutional distribution of responsibilities"* (80). Messerschmidt explains how he finds the greatest challenges concerning drones are human beings operating drones. Ethics and morality is required from human operating a drone, preventing misuses and accidents. Taking this into account Sky-Watch provides, as an adjunct to their drone production and research, education for drone operators. We observe that even though Sky-Watch enacts the drone as a matter of technical components, externalizing more 'subjective' concerns such as privacy, there is at Sky-Watch an awareness of the challenge of human operators. But Sky-Watch unlike the AAU research lab's focus on safety by design, they approach the challenge with education of the operator.

Cooperation with other actors

As previously elaborated there is collaboration between researchers and producers perceived in the collaboration of Drone Research Lab and Sky-Watch. The research lab have many partners with whom they collaborate such as other universities and agencies. la Cour-Harbo explains how Aalborg University is in the initial phase of creating a new knowledge sharing network, Dones@AAU, aiming to link together the various departments at the university, and actors from the drone industry. There is a need of a network, as he explains "...*sometimes (...) some companies says: 'we work together with another department placed on the other side of yours' and I* (la Cour- Harbo) *had no idea he* (here referring to another AAU university department) *worked with drones. And there is no reason not to take*

advantages of that synergy that may be created" (Interview with la Cour- Harbo 23:00). The practices carried out in the lab, creating inscriptions, include a palette of actors, both actors situated in the lab (like laboratory equipment and researchers), as well as actors with affiliation to other practices and other institutions. We understand la Cour- Harbo, representing the research lab, as a powerful actor with the ability and position to influence a wide range of actors. What is taking place 'inside' the lab and 'outside' of the lab is thus very much connected.

Drone Research Lab is depending on companies' and politicians' willingness to support research projects. Funding is essential for Drone Research Lab continue functioning, thus the lab has much at stake in keeping an ongoing interest in drone development and their role as experts. La Cour- Harbo explains the funding process as, "*companies put some money into the research projects, and then there is one, typically the government, through the government's annual budget, when you have applied for the money, which puts money into the research project. Then you develop new things that you have clearly defined in a research application*" (la cour- Harbo 36:10). This is true for Sky-Watch as well, as they are dependent on a continued marked for their drones. Again we observe that neither the lab or Sky-Watch exist or act on their own but are part of a larger network where negotiations between companies, politicians, research and labs are continually taking place.

Summary

At Drone Research Lab and Sky-Watch we see how the drone is comprehended as an aggregation of components and "*as inputs and outputs of calculations*" (Law & Mol 2001: 67) that can be manipulated to desired outcomes. The engineering drone is very much founded in the engineering culture; it is composed of mechanical parts and software. It is measured, experimented on, shaped and reshaped in laboratories as we see it in the case of AAU Drone Research Lab, where inscriptions in the form of scientific papers are produced through translation processes. Inscriptions, which other actors seem to consult.

The engineering drone is constructed and developed to accomplish tasks, and to overcome challenges navigating in the natural environment. This is done by isolating the drone or its components, experimenting and simulating real-world scenarios free from unwanted interference. We discover practices enacting a drone as a technology, which can be known and fixed, and the human being is viewed as a threat to the drone because the human is the

unknown and unpredictable factor. Thus, the practices that are enacting the engineering drone enact safety to overcome challenges with humans and technical error or just irresponsible human behavior. This is done either by designing for safety or through teaching human operators. It would seem though that human concerns for privacy and security are externalized. Finally we observe that both have much at stake in the continued interest in the drone development.

4.3.2 The emergency drone

We now turn to The Danish Emergency Management Agency (DEMA) that we visited in Tinglev. DEMA implemented drones in their work in 2014. At their department in Tinglev, Southern Denmark they have acquired 2 drones, the model is phantom quadcopter produced by the Chinese company DJI. This model were chosen as it is relatively inexpensive with the functionality needed, such as a HD camera attached, however, the model can not function in rain and is limited in further functionality expansion, such as attaching a Infrared (IR) sensor because it can not handle the weight.

Pic. 4.11 The phantom quadcopter belonging to the department of Tinglev.

The drone as a leadership assistant tool

At DEMA in Tinglev they train leaders in a variety of possible scenarios. They have their focus on 'specialized situations' and they provide special courses for incident commanders

educating approximately 50 incident commanders pr. year. Practices of tactical use of drones are now being taught in Tinglev, and for the moment 4 drone operators are educated, which involve a 2-3 days of course.

Head of section Per Teglgaard explains how drone operators are sent in the field when an incident occur, and operators ideally work in close contact with the commander, as the drone provides an important overview of the site. This is the advantage of the drone: it enables pictures from the air. That was something not commonly possible previously as the only method available was via a helicopter, which is an expensive and rare method to utilize at DEMA. The drone is more mobile, it can reach down to 2 meters, a task a helicopter would never accomplish. For instance a flying drone equipped with camera near the incident can monitor an oil spill or a fire in a building. Teglgaard argues that the drone can be perceived as an extension of the human eye, an opportunity to view the incident from a different perspective. Using the drone to generate an overview of the incident makes identification of potential endangered people and properties more effective. Teglgaard imagines a future where the drone is being operationalized already in the initial phase, what they define at DEMA as the 'chaos phase', the phase that begins when they receive information about a potential incident, such as a 112 call. At this stage the scale and particulars of the incident are still unknown, the drone can potentially be sent out immediately to the incident providing a visual live stream of the situation. Based on the life stream pictures from the drone, the incident commander can, on his way to the incident, prepare a strategy on how to deal with the incident when he arrives at the scene. DEMA conceptualizes and enacts the drone as a *leadership assistant tool* that provides a visual overview of an incident and thereby potentially enables better and more effective solutions for handling the situation expediting the rescue service.

For the moment drones are not being dispatched immediately as this would require flying without line of sight (BVLOS), which is still illegal and for now technologically not feasible due to poor reliability.

Pic. 4.12 Lifestream pictures sent from the drone. Shown at a screen in the agency vehicle.

The challenge of integrating the drone in their practice

When visiting DEMA it became quite clear that the implementation of drones requires work because a drone does not easily fit into the already existing practices. In Tinglev we joined a training session that took place in the fictive city 'Alleborg'. The scenario was a car that had collided with an oil tank and now was on fire. The drone provided a clear and useful picture of the situation, not only could the car and oil tank be surveyed, but it gave a clear image of the drain covers. Drains are important to identify because if oil or other fuels entering a drain can cause a potentially very dangerous situation. During the training session we saw, and got pointed out by Teglgaard, how the potential advantages of the drone was not fully utilized. The drone operator was not in close contact with the commander and the commander seemed to make decisions on behalf of his habitual procedures and his experience, neglecting the assistance that the life stream pictures from the drone could provide. Human capabilities and intuition was trusted more than the new drone practice. Teglgaard elaborated how they do indeed have troubles integrating the drone with the incident commander's practice, as the commander seems to act upon his established experience, a practice deeply embedded at DEMA.

The situations can be dangerous and tense, the commanders work instinctively, and follow a set of guidelines based on decades of *practical experience.* Drones are not yet part of this guideline, or so familiar as to be used instinctively. This experienced based approach

somehow clashes with the technology of a drone, as the drone requires a specific socio-material assembly to be effective. We have identified the need of specialized operator, a camera attached to the drone, one tv-screen placed at the agency vehicle, another attached to the drone operator's backpack. The drone operator must have a walky-talky enabling him/her to communicate with the incident commander, and the incident commander must be in verbal contact with the operator, guiding him where to fly the drone, and images provided by the drone should be utilized actively.

Pic. 4.13 The drone operator operating the drone at a fire incident

Pic. 4.14 The drone operator is wearing a backpack with a screen

A crew of people is determined to act in a specific way for the drone to be effective. Teglgaard explains that 4 men are required to employ the full potential of the drone.

Pic. 4.14 The agency vehicle with a tv- screen streaming pictures from the drone

Thus, in the case of DEMA we discover how a drone requires certain human and non-human associations and certain practices to function efficiently that have not been established yet, but are in the making.

How DEMA relates to concerns about public rights.

DEMA has the authority to fly with the drone everywhere in an emergency situation, as law's are overwritten for emergency services when property and personal damage are at stake. The public's rights, such as *privacy* do not seem to be a part of DEMA's practice, as emergency situations overrule such rights if required. Citizens seem to acknowledge the importance of DEMA's work, as argued by Teglgaard, and are willing to cede some rights in the case of an emergency if it helps resolve the situation. This figures in no complaints raised by citizen at DEMA for their drone usage.

Concerns regarding drones

With the implementation of the drones follow some concerns. Teglgaard pointed out a concern on how the recorded data from an incident is being handled afterwards. Because the whole incident is video recorded by the drone at a accident scenario, it can later be contemplated if a commander was acting inappropriately, making decisions that are not 'by the book'.

Improvisation and following instincts is often the method used in situations where the commander is exposed to a changing situation and needs to adapt. The recorded material from the drone can be utilized in a lawsuit against DEMA, as Teglgaard explains has been the case in Germany. He explains that human mistakes are considered normal to the practice at DEMA, but out of context recorded videotape might highlight small mistakes and judge people for *just doing their job* because insurance companies often have an economic interest in shifting the responsibility for compensation from the insurance company to DEMA. This is not something they have yet experienced at DEMA and thus belong to a potential future scenario, but this dilemma seems to be something highly discussed at the agency. Another concern Teglgaard highlights is the speculation on whether the drones will come to replace jobs at DEMA in the long term. He informs how currently DEMA has already been downsized from 93 units in 98 municipalities to 25 units today due to cost savings a decision made by KL (Kommunernes Landsforening), an organization that represents Danish municipalities.

Summary

The emergency drone is being enacted by DEMA as an assistant tool and is a potential host to expediting and improves emergency services, as it provides an overview that has not been available beforehand. Drones cannot be effortless implemented at DEMA, we observe that certain socio-material assemblies are needed for exploiting the full potential of the drone. Drone operators are trained which implies that a degree of expertise is required to operate the drone. The incident commander as well needs to learn to utilize this new leadership assistant tool. It is required that the drone becomes part of practices at an instinctive level to be effective. As the drone will be implemented it will change existing practices, and it raises concerns within the agency. The drone is a potential host to data misuse, as well as a potential tool to question, sue, the agencies work. The drone could potentially legitimize further cutbacks and job loss within the agency.

4.3.3 The commercial operator drone

During the UAS Denmark's annual meeting 2016 we encountered the entrepreneur Ulrik Max Nielsen, founder of Dansk Drone Netværk a drone service provider company. Nielsen, during the interview, explains how his company came to be. It started by him acquiring a drone for hobby use; he started filming with it for fun and published a video on the internet. The video got a lot of interests and 5000 views in a week, and he sensed that there might be a business opportunity. As his video was not very refined, he saw an opportunity in creating a system that facilitated background tasks such as video editing.

Pic. 4.15 The view from a drone filming (Østergaard 2015)

Nielsen, as many other entrepreneurs, saw a business opportunity in this new technology, Danish Technological Institute (Teknologisk Institut 2016) identifies that 45% of the 294 Danish business who are registered drone users utilizes drones for media and film production. Nielsen comprehends a drone as a mean to obtain information in the form of data. As he states, data is what provides value to the customer. The data gathered by the drone is valuable to the customer but often very sensitive as well, and Nielsen, aware of this, manages the data very carefully, making sure that no copies are leaked. Competing businesses could potentially use the data gathered for a competitive advantage.

The commercial operator drone

Nielsen, as all other commercial operators, has gained permission by the Danish Transport and Construction Authority to operate the drone. This requires him to make and adhere to an approved operational manual that respects safety, and for him to be knowledgeable of the regulations in place. Nielsen notices in his everyday work that drones not always are that familiar to people and they attract attention from local community. Nielsen explains that he preemptively engages with the community before operating the drone. To make people feel safe, and not ruin his reputation, he often knocks people's doors informing them that he is flying the drone, what the purpose of his activity is, and answer eventual questions. The commercial operator drone, when enacted in a public setting, is perceived as a novelty potentially generating curiosity and suspicion in the local community.

Nielsen explains that operators like himself are indifferent to research and publications about drones as they are engaged in the harsh reality of selling their drone services to customers. It is required that they communicate the potential value of the drone as a data collection tool to skeptical customers. Nielsen is not too excited about the new legislation on drones as he believes it would not makes a difference for him and his colleagues because applying for permission to fly drones now or getting a drone license, as it will be after the legislation, is no improvement according to Nielsen.

Nielsen worries that the new legislation and the low price of drones causes more 'amateurs' to use drones, which, according to Nielsen, they are not always competent in. Some use drones in a way not complying with the current law, flying near private properties and in general disturb the privacy of the public. Scenarios as these can harm his business domain because drones get a bad reputation among the public, and he believes that the blame is often addressed to the industry. Because of this Nielsen finds that a distinction between professional and private usages should be made clear, through legislation. This attitude is to be found at the network branch association UAS Denmark as well, which Dansk Drone Netværk is member of. Nielsen is not interested in the politics of drones and he places his trust in UAS Denmark doing their job of working with the government and agencies.

Summary

The commercial operator drone is a new business that is met with curiosity and suspicion. The practice is therefore, in addition to operate the drone and gather data, to educate local communities and potential customer about what a drone is and what value it has. The commercial operator drone acts as an expert, both in relation to the expertise required to acquire permission to operate and in the engagement with customers and the public. We find indifference toward reports and other published scientific material, as it is not perceived by the operator to relate to the commercial operators everyday practice, as the politics of the drone are trusted to UAS Denmark. There is a concern for a growing 'amateurs' operator segment that are not always competent and knowledgeable in flying drones, giving drones bad reputation among the public and ruining the professional business. Therefore there is a desire for a clear legislative distinction between amateur- and professional drone operators.

4.3.4 The political drone

This chapter is based on an interview with Tino Rabe Tønnesen, chief consultant at Technological Network, IDA, news articles, reports and notes from UAS Denmark's annual meeting.

At UAS Denmark's annual network meeting we got introduced to the (at that point of time) forthcoming event of Nordic Drone Games by Tønnesen as he was one of the speakers at the meeting. Afterwards we did an interview with Tønnesen because we have not been able to participate in the event as it was held few days before submitting this paper. UAS Denmark (the Danish drone network branch organization) has been contacted in relation to their annual drone meeting and obviously present.

The political drone at UAS Denmark

The Danish drone network branch organization UAS Denmark has a practice of linking together various drone actors, ensuring the best conditions for the drone industry. UAS Denmark's practice includes lobby work for the government and related organizations, in order to ensure this nurturing environment for drone business. As previously mentioned, in the historical review (4.1), they are perceived as the organization that introduced drones to the political agenda.

UAS Denmark is perceived, and acts, as expert of the drone industry and has status of being a spokesperson on behalf of the whole drone industry with over 80 members. This is exemplified in letter to the ministry concerning the, at the time, forthcoming legislation:

> *"A survey of UAS Denmark's members shows that a dominant part would recommend that also private drones above a certain size (the minimum threshold) are recorded in order to reduce the risk of accidents, etc., which can potentially have a major negative effect on a new industry in large growth"*(Own translation) (UAS Denmark 2016 i)

This shows a concern among UAS Denmark of the private, amateur use of drones, as Nielsen from Dansk Drone Network also addresses. In order to overcome this challenge, UAS Denmark recommends that it is being required to make registration of drones accessible for

the police. Within the registration process private people should be informed about the drone legislation. UAS Denmark appears to perform the interests of the industry and the professionals, and not the private or amateur users. We introduced in the chapter '*Stories about the interconnectedness of the actors'* (4.2) how the program of 'drone development in Denmark' was constructed by association of socio-material assemblies. UAS Denmark's practice of the political drone is to produce inscriptions such as the report Oxford Research (2015) and communications to government and agencies promoting the industry's agenda. UAS Denmark produces conferences, meetings and events, as the annual meeting we attended, where members meet and politicians are present. For instance Hans Christian Schmidt, the Minister of Transport and Building and deputy director general of the Transport and Construction Authority, Jesper Rasmussen was invited to speak at the meeting.

The political drone at IDA

Nordic Drone Games is held as part of the Nordic UAS event, the largest UAS expo, conference and demo in Northern Europe, at the Hans Christian Andersen Airport, Odense- the location of UAS Test Center Denmark. Tønnesen describes that the event (Nordic Drone Games) includes drone competitions (such as drone races), showcasing of drones, and speeches. The event is open for all with an interest or curiosity, as the description reads on Facebook *"NORDIC DRONE GAMES - a day for you who can not resist drones, or will encounter drones for the first time. Discover wild drones, cool demos, advanced drone challenges and get updated state-of-the-art knowledge from inspirational speakers"* (IDA 2016).

Tønnesen explains how he envisions that the audience, students, organizations and drone experts at Nordic Drone Games can engage with one another, because he views that an important feature of the event is to create connections between developers and users. By the event, drones and, in a broader perspective technology, are attempted to be associated to something fun and positive. IDA's, and therefore Tønnesen's ambition for the event is to promote the field of engineering, to spark an interest for technology in students and hopefully nudge future students toward the field of engineering and natural science. IDA as trade union for engineers has an interest in the growth of the engineering field.

Tønnesen explains that another focus of Nordic Drone Games is to create a situation that can facilitate connections between politicians, the industry and start-ups:

> "*if they* (the drones) *should be able to do something, like have an application attached, we believe that Danish engineers can play a role. And Nordic Drone Games* (...) *will focus on that* (...) *the idea is to link politicians, and start-ups and organizations who believe there is a market. It could for instance be examples in agriculture* (...) (Interview with Tønnesen, 7:38).

Tønnesen believes that we in Denmark do not hear much about drones, and events like Nordic Drone Games could increase the awareness of drones. As both a public and a professional segment is expected to be represented, Tønnesen elaborates, how the event can facilitate awareness of drones *"it is very much about standing over a table with the drone in the hand, and talk about it, or standing right beside while the drone operator is present. And the communication is quite interesting because it helps to spread out the fascination of the technology "* (Interview with Tønnesen 18:48). Tønnesen, when asked, defines a drone as a remotely unit able to fly in 3 dimensions, which is fun, has a lot of potential and an impact on the development of companies. The drone seems enacted as a gateway to interest in technology and engineering and as a medium to help the industry for Danish engineers.

Summary

We have a practice of been an expert on a group of actors; for UAS Denmark it is the drone industry and for IDA it is engineers. The drone is enacted as inscription, communications, conferences and events to pursue the interest of the organization. It is an apparent political drone. In the case of UAS Denmark it is enacted to pursue the interests, interpreted by USA Denmark, of the industry and the professionals. IDA enacts the drone to create interest in technology and engineering and to help the industry engineers.

4.3.5 The sport and play drone

This chapter introduces what we name the sport and play drone. We draw upon the drone race that is one event of the Nordic Drone Games and the emergent concept of drone-dress-ups where we discover a practice enacting the drone as something fun and fascinating. Drone-dress-ups were introduced to us by an event held at Herlev library. Drone races is probably the most popular and known sport, or game, with drones and it is gaining popularity ''*Drone racing is currently seeing an unprecedented rise in popularity and is poised to become the next behemoth racing sport alongside NASCAR and Formula 1*.''(IDRA & ESPN 2016:1). As it is gaining notoriety it is trying to define itself as a competitive sport. International Drone Racing Association (IDRA) was established in 2015 and recently negotiated a drone race broadcast deal with ESPN (IDRA & ESPN 2016). Another drone emergent concept seems to be drone-dress-ups where drones literally get dressed in clothes, flying up in the air providing entertainment for an audience consisting, a mixture of workshop and catwalk. A show like this was held at The Danish library Herlev (Nielsen 2016).

The sport and play drone

The most popular races are FPV stands for first person view. These races are practiced similarly to other type of races, such as Formula 1. There is a course; around the course there are seats for spectators and big screens showing footage of the race. Winners get prizes, sometimes monetary prizes. They also differ, the race driver or drone operator, wears glasses so he sees what the drone sees, this is how he flies the drone around the course. The video feed is projected on the screen to give the spectators an immersive experience. The spectators engage as they do with other races, betting on winners and having a favorite team they hope to win. For more information see for example Andersen (2016) video of the World Drone Prix 2016.

Drone dress up in Herlev library was composed of a mixture of workshop and catwalk. A professional drone operator provides drones and tutorials in flying for the participants. Then during a workshop the participants modify the drones with materials, creating 'dresses' for the drones. Afterword the dressed drones are revealed in a sort of 'catwalk'.

Drone dress-up and drone races are a practice where professionals, experts, enthusiasts, and just curious members of the public enact drones together, albeit some as spectators

and some as participants, with fun and fascination. We argue that by activating the public in the practices of drones, the drone is actually enacted as something relevant to a public. McDonald (2015) in Discovery Communications writes how fun and drones can be associated with each other, which may be a counterpart to the negative associations of drones:

"*Drones are getting a bad reputation these days, what with illegal surveillance, and drug smuggling and all. But some drones just want to have fun. Hobbyist, DIY enthusiast and even professional performing arts groups are starting to explore the fun to be had with dressing up drones*" (McDonald 2015).

The fun and games drone could potentially gives rise to public understanding of drones.

Summary

The fun and games drone enacted is a potential host to public involvement and public awareness of drones. The fun and game is a practice potentially co-created by ordinary people and professionals through fun and fascination. With drone races and especially drone dress-up, fun and the game elements are being practiced, in some cases 'through hands on'. In some cases it could be considered a practice open towards a mutual and direct participation of public and professionals.

4.3.6 What does enactments of the drone reveal about the development path creation?

Our multi-sited ethnographic research design allowed us to 'track' the drone in various contexts. We have shown, by telling simplified stories of the various versions of the drone, that different practices enact the drone differently, to say it in a simple manner: we discover a 'drone multiple'. An engineering drone, an emergency drone, a commercial operator drone, a political drone and a sport and play drone. But this multiplicity is not plurality (Law and Mol 2008:66). There are relations between the various versions of the drone that both exclude and include each other.

If we resume the engineering drone we met at AAU Drone Research Lab and Sky-Watch, the drone is a drone isolated from the environment and humans, which is contrary to the

emergency drone and the commercial operator drone that is required to exists in the environment and co-exist with humans. The engineering drone is constructed and developed to accomplish new tasks, and to overcome new challenges navigating in a natural environment, this is 'good' for DEMA and operators as it enables the drone to accomplish more tasks, such as flying BVLOS. But it is 'bad' as well, as practices change, becoming more effective; it might legitimize cutbacks and job loss. When the technological drone is shaped and reshaped it requires existing practices at DEMA or from commercial operators to adapt, but in turn new practices from DEMA and commercial operators influence the necessity of new shapes of drones, influencing the engineering drone. AAU Drone Research Lab is actively cooperating with various companies in an effort to produce drones that fulfill various requirements.

The engineering drone is analyzed, experimented on and tested, producing inscription, such as safety limits. These inscriptions are included in the political drone and are taken in consideration by policymakers and legislators and then often reproduced in new inscriptions as policies, guidelines or legislation. These guidelines then effect the emergency drone, commercial operator drone and the fun and game drone, it is good as it can potentially minimize dangerous practices, but it can also, in some cases, exclude practices as some incompatibility might arise with the guidelines.

The drone has a price; Sky-Watch sells its drones at a high price as they are producing specialized drones at lower quantities. The high price of Sky-Watch's drones restrained them from producing drones for international aid agencies and instead had to focus on producing drones for emergency agencies and the military as they could pay the price of the drones. This follows Braun, Friedewald & Valkenburg (2015) finding that military and emergency agency, because of their budgets, are dominant customers. For Sky-Watch the price of the drone is a matter of survival, if they do not sell drones for a profit in the long term, they might face bankruptcy as happen to Little Smart Things, as mentioned in the *historical review* 4.1. For DEMA the price of the drone has to be compatible with tight municipal budget, this is the reason they primary work and train with the cheap Chinese drones and not Danish produced Sky-Watch drones. Cheap drones also afford the opportunity to bring the drone in dangerous situations more often as they are more

expendable but the Chinese drones have their restrictions as well as they cannot carry all the equipment DEMA wish to utilize. For commercial operators the price of the drone is evaluated in relation to the economic value the drone can generate, as well here the cheap Chinese drone is preferred according to the report from the Technological Institut (Teknologisk Institut 2016) as it fulfills the commercial needs at a low price. The availability of cheap and really cheap drones is arguably one of the reasons drones are gaining commercial momentum with hobby users or just as a toy and businesses alike.

Img 4.16 The image illustrates that drones are cheap, you can get a drone for free for two month subscription (Illustreret Videnskab 2016).

The drone enacted reveals practices that are practiced as 'local' for example practice we find enacting the commercial operator drone of engaging local communities or the emergency drone practice of instinctively management of dangerous and tense situations. These practices appear obvious heterogeneous as nothing universal is being claimed and local because they do not practice

As concluded in the previous chapter, where we analyzed connections between actors, it appears that just a limited number of interconnected actors are perceptually dominating the development path creation, promoting a program of "drone development in Denmark". In our effort to uncover the complex relation of the drone enacted, we find as well practices that are being practiced as universal from the dominating actors for example the political drone practice representation, legislation and inscription or the engineering drone practice

controlled experimentation and inscription. These practices appear as hegemonic realities, "(...) *enacting realities in ways that assume these to be generally, even universally, applicable"* (Singleton & Law 2013: 270).

The practices that are performed as 'local' appears as subordinate realities within the development path creation to the more apparent and colonizing practices of hegemonic realities. We call this colonizing practice *the singularity push* that is closely related to the program of "drone development in Denmark". To further understand the development path creation our concern shift again, we ask what is the singularity push? What converging practices reproduce this colonizing practice?

4.4 Discovering the singularity push

We have chosen to define the singularity push by 3 convergences, these 3 convergences are what we find to be the most perceivable and descriptive, but this is a simplified representation as more convergences can easily be found. This paper uses the term *convergence* to describe the process of reproductive practices in a seemingly hegemonic reality. The singularity push is particularly evident in inscriptions such as reports, legislations but is found resonating in practices as well.

4.4.1 Convergence 1: The professional tool

The first convergence, is the drone enacted as a professional tool, in the sense that it requires a degree of expertise, of knowledge to be operated desirably.
Going back to the engineering drone, we see a practice similar to Schein (1996) assumptions about engineering culture. A practices of engineering humans out of the technology, concerned about safety by design as illustrated about the experiments with drone crashes, and as stated by Messerschmidt from Sky-Watch that he finds the greatest challenge concerning drones are human beings operating drones. Sky-Watch has initiated education programs for drone operators providing expertise to the operator. This professionalism is reflected in the practice of the commercial operator drone, where Nielsen from Danish Drone Network articulates how professional operators have the expertise to operate the

drone responsibly, and amateurs operators are not necessarily competent enough and could cause accidents. Our actors UAS Denmark and Dansk Drone Netværk calls therefore for higher standards of regulation and expertise, in the form of a drone license for private and amateur drone operators, reproducing the drone as a professional tool that can be misused by the uninformed non-professional users. This professional *drone* is echoing in reports, papers, and a key part of the passed legislation that focuses on a drone license as well. The overwhelming domination of engineering and natural science publications regarding drones as illustrated in the diagram fig. 4.18 which is a subject distribution of publication with keywords containing *drone* and *UAV* or *UAS* extracted by Scopus. (The percentages give more than 100% as publications can have multiple subjects, but it is noteworthy that only 12,5% are social science related compared to almost 60% engineering) arguably reproduce and preserve the assumption that drones require expertise, enacting drones as a professional tool (if we are to follow what we have already experienced throughout the analysis).

Another contributing factor for the domination of this assumption is arguably that the consultation process and debate concerning the new drone legislation has been limited to a small group of actors, presented in the chapter actors interconnected as this reproduces the dominant actors positions. By enacting drones as this professional tool, it then requires an instruction and education to be understood and used in an appropriate manner. This could explain the wide agreement from different reports, agencies both from EU and Denmark, that regulation and a legislations such as a drone license is essential to exploit the full potential of the drone development. Drones as a professional tool seem to perform a patronizing practice where amateurs, hobby users and the general public have to be

instructed.

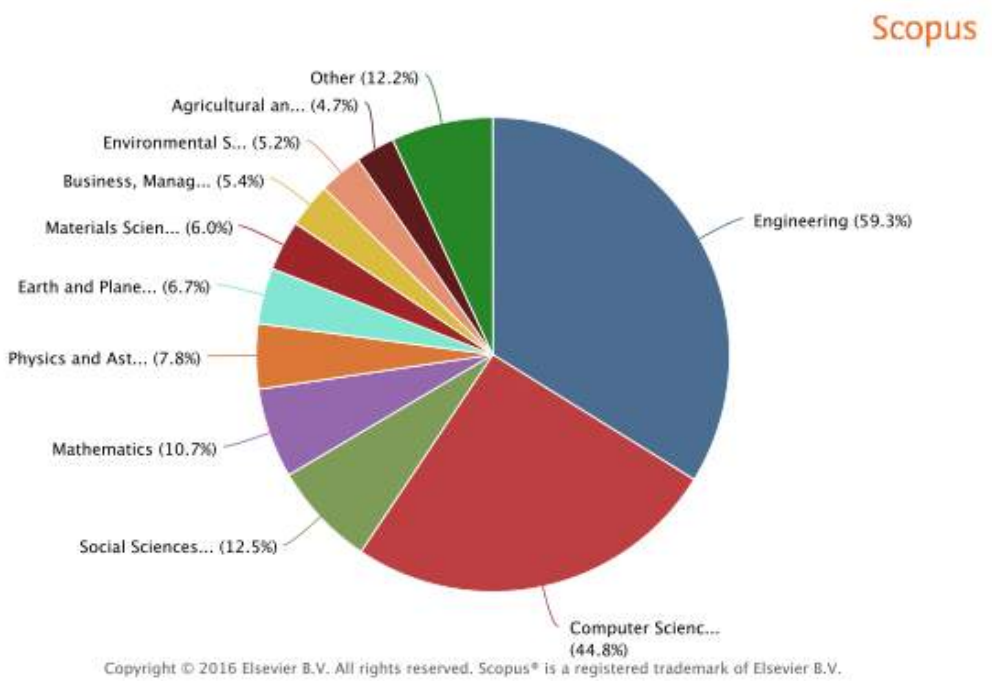
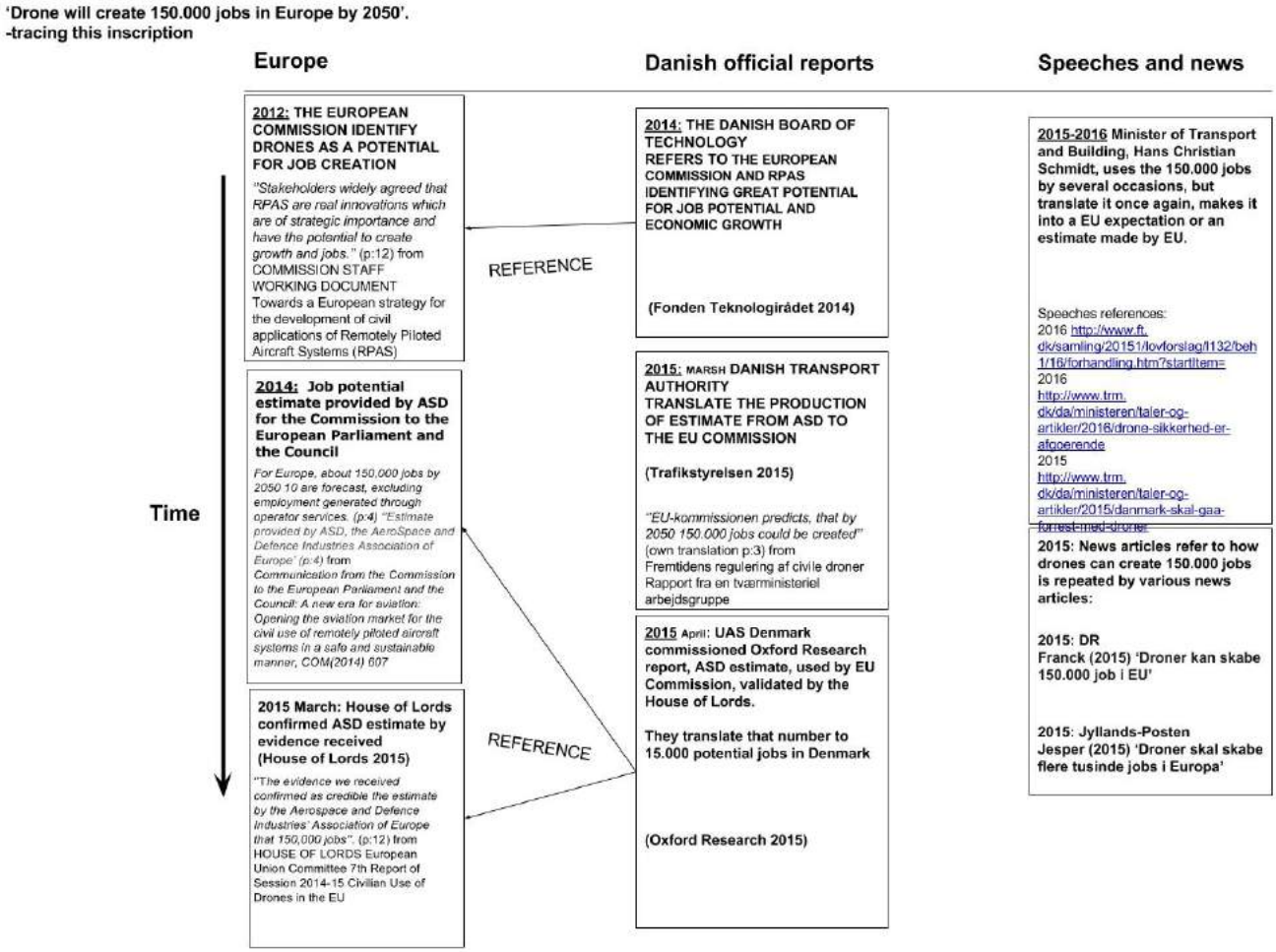


Fig: 4.18

4.4.2 The convergence 2: The potential

We have encountered an overly positive attitude towards the potential of drone technology. Drones are often portrayed as '' (...) *a real opportunity to foster job creation and a source for innovation and economic growth for the years to come*'' (European Commission 2014a :9). The report from the Danish Board of Technology (2016) identifies that most publications from last year agree on the massive potential for economic growth for the drone industry and related services, there exists an almost euphoria surrounding to this potential as the Danish Board of Technology (2016) phrase it. Danish Drone Netværk writes on their webpage that the drone is in exponential growth, and during the meeting with DEMA we got the impression they as well see almost unlimited possibilities for drones. Similarly we encounter this belief of the almost unlimited potential of drones in our encounters with other actors. This was also a strong theme at UAS Denmark's year meeting. More specifically we observe 150.000 jobs as a figure frequently used by the European Commission. (2014,a), and many other related documents), UAS Denmark (2016) and the Danish Transport and Building Minister Hans Christian Schmidt (2015 a, b). This

figure is also frequently presented in reports, as well as this paper, to validate the importance of drones. We have traced the recurring *150.000 jobs creation* inscription to understand how it is mobilized, illustrated in the figure. We have chosen to illustrate this traced inscription because it transforms as it gets translated. The 150.000 jobs is an estimate done by the industry trade group The AeroSpace and Defence Industries Association of Europe (ASD), predicting the number of jobs that could be created in Europe by the year 2050 from drone activity.



We notice with this trace a reluctance to refer the lobby organisation ASD when utilizing this inscription. Only when House of Lords have validated the inscription it seems to be more common to refer to ASD, but only in combination with the validation of The House of Lords. This could be a conscious selection of the most powerful ally (EU) as opposed to a lobby organisation, in an effort to empower the inscription and hence promote the program

of "drone development in Denmark". A goal has been set by the European Union to make Europe a global leader in the drone industry (House of Lords 2015) in an effort to tap into the potential. The Danish Transport and Building Minister has similarly set a political goal of making Denmark a front runner nation for drone activities so that Denmark can import some of the potential or as the minister phrase it *''exploiting the drone potential"* (own translation) (Schmidt 2015 b). There seems to be unanimous agreement, at least in all interviews and material used for this paper, that this potential exists and the drone industry will continue to grow, almost like it is destiny, this is how we define as the second convergence. The recent bankruptcy of Little Smart Things, 1 of Denmark's 2 major drone manufacturing companies, do not seem to have shaken this belief, or the fact that one company in China, DJI, is dominating the civilian drone marked with a 70% world market share.

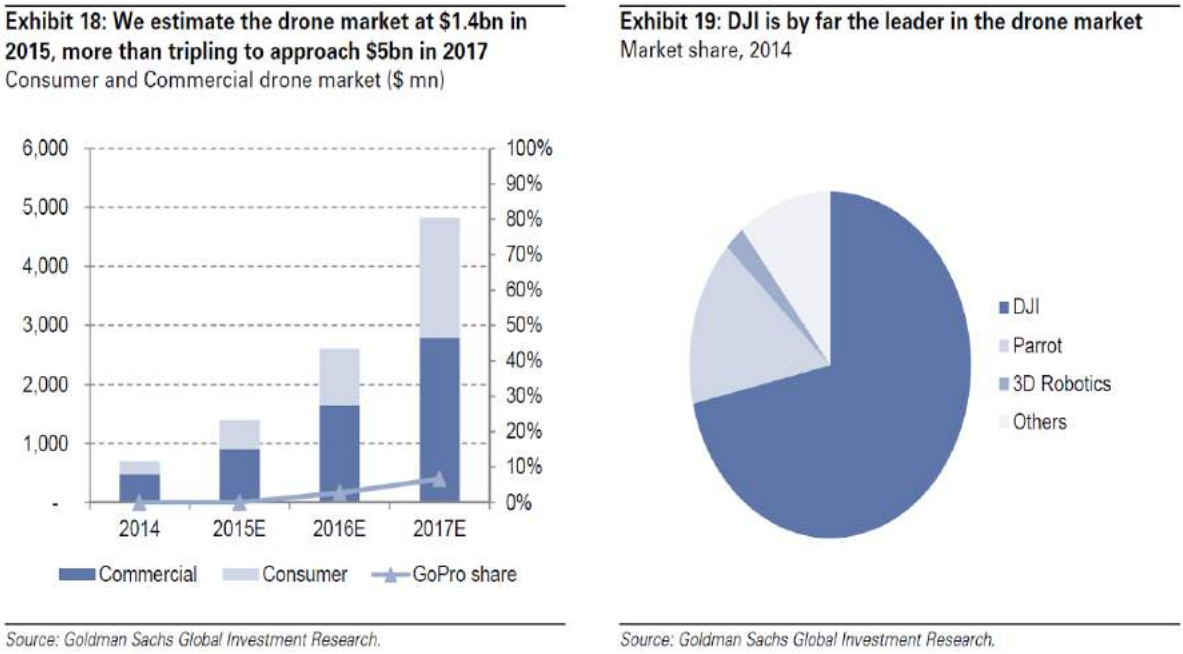


Fig. 4.17 (Robotics Tomorrow 2016)

Regulations and legislation often follows as a requirement to exploit the potential as can be found in the European aviation community's conclusion on exploiting the drone potential. *''The aviation community stressed the necessity for European regulators to ensure that all the conditions are met for the safe and sustainable emergence of innovative drone services.*

At the same time regulations must help the industry to thrive and adequately deal with citizens' concerns" (The European aviation community 2015:1). This statement, often similarly reiterated, relates to the first convergence of the drone as a professional tool. The drone needs a degree of expertise and knowledge to be operated desirably, and this leads us to the 3. and last convergence of public acceptance.

4.4.3 The convergence 3: Public acceptance

We have encountered as well an undisputed assumption of the requirement of public acceptance. This assumption is almost unanimously present in papers, from Denmark as well as the EU. This assumption is inscribed as essential: ''*Public acceptance is key to the growth of drone services.''*(The European aviation community 2015:4).
''*To achieve stable growth a broad public accept is required*'' (own translation) (Trafikstyrelsen 2015: 13) ''(...) *necessary to create trust and accept in the broad public''* (own translation) (Fonden Teknologirådet 2014: 24) and indirectly *''Misuse of RPAS by leisure users could undermine public acceptance of this technology, potentially jeopardising the development of a commercial RPAS market*" (House of Lords 2015:5) and many more direct and indirect inscriptions. Public acceptance is presented explicitly as the critical achievement for the success of the drone development path. This is presented as well as a reason for failure. Some of our informants (Tønnesen, la Cour-Harbo) and the Minister of Transport and Building are articulating fear of 'one accident' shifting public opinion which may threaten the whole drone development path (noticed at UAS annual meeting).
This final convergence re-relates strongly to the enactment of drones as professional tool, and emphasizes regulation as the method to achieve public acceptance. We see drones as a professional tool, undisputed potential and public acceptance, strongly interlinked and enacted as one, *the singularity push*.

4.4.4 Summary

The singularity push is presented to appear coherent and consistent as it is echoing through different papers and presented by different actors. It appears almost like destiny, as no

other reality exists. Drones are portrayed as an inevitable consequence of technological development and have come to stay (Trafikstyrelsen 2015; Transport- og Bygningsministeriet 2016; Fonden Teknologirådet 2014). As Law (2004) concludes *"the presupposition of singularity not only hides the practice that enacts it, but also conceals the possibility that different constellations of practice and their hinterlands might make it possible to enact realities in different ways"* (67).

To recap, we have chosen to define the singularity push as 3 convergences that stage the assumption of a drone as professional tools with an undisputed potential that requires public acceptance.

4.5 Analysis summary

The just presented analysis is approached from 3 perspectives. The 3 perspectives should not be understood as separate but as methods to zoom in and out of the material, where we gradually perceive the drone development path, its actors and practices.

It is clear that no single actor or a specific moment in time alone created the development path. It is rather an evolution where producers, regulators and research institutions are introduced and disappear manifesting themselves in important events. There is a continued institutionalization of the drone in interest and industry networks, research institution and the government. The development path creation at this time appears as dominated by a limited number of interconnected actors, predominantly institutions. An assembly of actors more or less attached to the program of "drone development in Denmark", maintained and developed by an accumulation of inscriptions, institutionalization and alliances. The assembly of dominating actors' practice a colonizing practice, what we call a *the singularity push.* We define a simplified version of the singularity push as the assumption of a drone as professional tools with an undisputed potential that requires public acceptance.

Investigating the enactments of the drone reveals practices that are practiced as local but appears as subordinate realities within the development path creation. These practices appear heterogeneous as nothing universal is being claimed. The singularity push on the other hand is presented to appear coherent and consistent as it is echoing through different papers and presented by different actors.

"The reality-enacting practices of capture are powerful (...)" (Singleton & Law 2013: 270) But applying a multiplicity perspective opens up the possibility that realities might be otherwise (Law 2004). We have already discovered the subordinate realities practiced as local by investigating practices but in relation to this paper's research question *how are drones, legislators, institutions, users and organizations interconnected and shape the development path creation in Denmark?* And *what might happen if the dominant practices are re-multiplied and respond to subordinate practices of civil drones?*
we find it appropriate to discuss the practices and strategies pursuing this singularity push and the created *collateral realities*, afterward we attempt to re-multiply the singularity push presenting different stories of *models* of understanding.

5.0 Discussion

The discussion will primarily revolve around the singularity push as defined in the previous chapter of the drone as professional tool with an undisputed potential that requires public acceptance. There will be discussed what is present and absent in the practice of the singularity push and necessarily what collateral reality is created by this enactment. Finally two stories will attempt to re-multiply the material, presenting a multiple perspective on reality-enacting practices. We argue this approach as the potential of being more inclusive and empower practices that are practiced as local within the Danish development path creation. This part will discuss the enactment of the public acceptance, because we consider this practice interesting as an apparent a colonizing practice that is enacted explicitly.

5.1 Strategies of othering the military drone from civilian drone

As argued in the historical analysis part civil drones seem to originate from the military use. We find a concern among Danish politicians that citizens connote to the military use when facing civil drones. It is therefore obvious to involve the perspective of the associations or dissociations with civil drones and military drones, why we here discuss that topic.
Our study reveals how there appears to be little concurrence between the military drone and the civilian drone as none of our informants mentioned military drones when discussing civilian drones, albeit as this is not the focus of our paper, we never directly questioned about the concurrence between the military and the civilian drone. Worries about the public creating an unified image of the drone, combining the military and civilian drone, as well as the assumption that the public have such an unified image of a 'killer drone', are expressed in the European RPAS Steering Group report ''(it) *is important to modify the vision of "killing machines" they* (the public) *have right now due to the actually military-specific utilization and to some catastrophic movies*'' (ERSG 2013:30). Similarly the House of Lords (2015) noted that English Heritage observed that *''the term 'drone' was often used in the media, and that "its military connotations bring a negative association to many parts of the industry"*" (House of Lords 2015:62). In the Danish report from the Danish Board of Technology (Fonden Teknologirådet 2014) they as well perceives this negative association with the word drone, they apprise though, that the negative affiliation to the word drone and an existing debate about privacy could affect distrust toward government drone usage,

because a mistrust might already exist toward government agencies invasion of privacy. Effort has been made to try to rename the civilian drones with acronyms, such as UAS used by UAS Denmark, though without luck as observed by the Danish Board of Technology (Fonden Teknologirådet 2014). Within the singularity push framework a practice of othering the military drone seems present based on the assumption that the public do not distinguish military and civilian drones, and the word 'drone' is having a negative connotation with the public. We observe a confidence in these reports that civilian and military drones are two distinct objects.

Within the research done for this paper we have not been able to find any substantive study that empirically validates the assumption that the public do not distinguish military and civilian drones, this is congruent with both Boucher (2015) and Clothier et al. (2015) studies. Braun, Friedewald and Valkenburg (2015) argue that the military drone discourse travels with the civil drones, challenging the notion of two distinct objects. Arguably civilian drones are performed via a *relation of absence* to the military drone within the apparent singularity push (Law 2010) performed by giving the public a different vision of a drone in an effort to generate public acceptance. Although as observed by Braun, Friedewald and Valkenburg (2015) 'drone producing' companies often produce both military and civilian drones as is the case with the only Danish producer Sky-Watch, where Friedewald and Valkenburg (2015) point out that civilian drones are often demilitarized military drones repurposed for civilian use.

5.2 Avoiding controversy and negotiations

The process and debate for introducing the civil drone in Denmark, as discussed previously, has been limited to a limited group of actors involved in the production, research and legislation. Even though most publications are publicly accessible at the respective agencies, noticeable little public involvement seems to have taken place. Hayes, Jones and Töpfer's (2014) investigation of EU's process of introducing civil drones to the EU, reveals similarities to the Danish process, in the effort to technocratic manage the process through "roadmaps". Danish roadmaps can be found with the development of the Danish National Drone Strategy or the UAS Denmark roadmap (UAS Denmark 2016 g). The policies and

reports are as well developed behind closed doors by different expert workgroups, only revealed when finished. Hayes, Jones and Töpfer (2014) observe regarding the EU that ''*the entire process appears to have been designed precisely to avoid any substantive discussion or debate by pre-defining policy objectives and outcomes*'' (77).

Throughout the empirical research we seem to identify a prevailing idea that the 'single accident' can change the attitude of the civil drone among the public, and hence affect the whole drone industry. The Minister of Transport and Construction encourages drone operators to spread positive stories about the usages of the civil drone and use caution. The Minister did warn the assembly at the UAS Denmark's annual meeting that a skepticism toward drones might occur among the public if negative stories are shared in the media (UAS Denmark 2016h) like for instance drones used for espionage and for the smuggling of objects into Danish prisons, recent stories portrayed in the Danish medias (Mette 2016).

When concerning the public 2 political strategies appear to outline the introduction of civil drones in Denmark:

1) To keep the process away from the public.

2) To avoid any accidents that might spark a public debate.

We ask why these 2 strategies might develop? And further, how the strategies reproduce the singularity push articulated by a small group of experts and politicians, which seems to be done by avoiding a public debate.

One explanation might be found among the influential actors, as described by Boucher (2014) regarding the ERSG strategy's desire of *''*(...) *public acceptance of the vision of civil drone development as articulated by industry and policy experts"* (Boucher 2014:39). This could indicate that the decision maker's understanding of the public as inadequate to engage in the co-construction of the vision; that very little trust is given to the public's discernment in this area, wanting to have a one sided flow information from the stakeholders and experts to the citizens. This relates quite well to the assumption of drones as a professional tool. The influential actors might be aware that drones are heterogeneous within the public, which might start debate and controversy undermining the coherent singularity push that has been developed, empowering the practices that are practiced as local. The drone, during the treatment in the Danish parliament of the drone law, passed unanimously without much debate. This would seem to indicate that the development vision is stripped of even political controversy. The effort to keep the civil drone

uncontroversial, away from public debate, may be found in concurrence with the effort to keep the military drone as separate, as the military drone is a highly controversial subject both in scientific literature and in the public debate, and this controversial might be viewed as threatening the civil drone development.

We might have stepped upon a self -reinforcing mechanism for an ontological singularity. As we have previously concluded, there is a wide consensus by industry experts and reports of the drone as a professional tool, this tool in return needs clear legislation to be publicly accepted and its potential exploited. As policies require coherence, consistency to be effective, (see for example van Reisen (2007)) it reinforces the established practices of the drone as singular, coherent and consistent externalizing controversy. What is present is a coherent, singular uncontroversial vision of the drone development, absent, we might say is un-coherence, controversy and political negotiation.

This singular drone, this ontology would seem to create a collateral reality, a specific assumption of public acceptance. This assumption can be found echoing in the legislation, recommendations from different papers, and concerns from the influential actors. This might be best expressed in the fourth paragraph in RIGA DECLARATION ON REMOTELY PILOTED AIRCRAFT (drones) by the European aviation community (2015) a document that provides the principles to guide the regulatory framework in Europe. In this paragraph entitled 'Public acceptance is key to the growth of drone services' it is stated that: *''The respect of citizens' fundamental rights, such as the right to privacy and the protection of personal data, must be guaranteed* (...) *and negative externalities, such as noise* (...)''(European aviation community 2015: 4) must be addressed and that potential security risks must be taken into account.

Public acceptance is therefore 'simply' addressed by fulfilling those 3 criteria, implying that no further public involvement is necessary. This might explain the lack of studies of the public concerns about drones, and the lack of effort in public involvement. In this ontology it is simply absent.

5.3 The collateral reality of the public

The singularity push contains a reality where politicians, the industry and businesses have much at stake in the effort to capitalize the potential hence Denmark's goal of becoming a world leader in drone technology. As previously mentioned we might have identified a self

reinforcing mechanism within the singularity push that helps explain the lack of plainly visible *politics of the real* (Law 2009), not to exclude that some negotiations have probably happened behind closed doors in working groups. What is *absent* (Law 2002) from this singularity is non-coherence and controversy. In continuation we observe public acceptance, echoing as a critical achievement for the development of the technological path, defined as 3 parameters, that manipulated or rather conserved will achieve this goal. Those parameters, the public fundamental rights such as privacy, security and nuances such as noise, can metaphorically be viewed as lines on a graph were on the X axis we have a quantifiable amount which changes with the introduction of drones on the Y axis we have a quantifiable public acceptance. The graph line can then dip below a threshold and the technology will become unacceptable to the public or stay above and be accepted.
A collateral reality of this version of public acceptance is an assumption that 'all the' public is consistent, understood as a threshold limit, and that the drone is singular as all drones are affecting only those three parameters. This public acceptance is quantifiable, easy to manipulate absent of non-coherence and controversy. We find a, to us, surprising consistency and coherence in the singularity push and lack of apparent negotiation.
If public acceptance can be addressed by solely adjusting the previously mentioned 3 parameters, we might say that it creates a collateral reality where the public does not need to be addressed empirically to understand acceptance as this is encompassed in the assumptions. This would further explain the lack of empirical studies about public acceptance of drones. As we will discover in the next chapter, two small studies have been made, which will be discussed because we find these studies provide a resources to re-multiplying the drone, reopening the drone field, what we call *The story of inquiring.*
Further we will discuss how 'bottom-up practices' can be another significant resource for opening the material up again, what we name *The story of collective practices*.

5.4 The story of asking the public

As mentioned, a few studies have been published which empirically investigate public acceptance of drones by involving the public in the study (Boucher 2015; Clothier et al. 2015). These studies are relatively small, one involving a couple of focus groups with people from Italy and UK, the other involving a survey with Australian citizens. These studies reveal

something interesting, one is that the public perceives drones by their practice and the other is that the prevailing assumption about public acceptance enacted by the singularity push, are not necessarily reiterated by the public. This is the story that is told in this chapter. Boucher's (2015) focus group study in UK and Italy and Clothier et al. (2015) survey in Australia concludes that acceptance and concern with drones depend on application, and opinions about drones are most strongly generated by personal experience rather than news and movies. If we ought to believe that these public perceptions are present in Denmark as well, then the public do not necessarily recognizes the drone mobilized in the singularity push, they see drones as multiple depending on practice. They are more strongly influenced by personal experience with drones; one might say when they have something at stake.

The studies reveal as well, that some of the assumptions about public perception, which seem to generate the foundations for the development public acceptance of drones, are not prevailing matters of concern for the public. Clothier et al. (2015) do not find the negative connotations to the word 'drone' expressed in various reports (Teknologirådet 2014), Boucher's (2015) study shows as well that the concern of the public perceiving drones as killer machines was not shared with the subjects involved in the studies. Both studies shows that privacy and safety are not the public biggest concern, Boucher (2015) finds that the public has gone used to be surveyed from CCTV & so on, and perceive lack of privacy as an unfortunate consequence of modern life. The public do not believe in, the previously discussed undisputed potential for job creation and economic growth drones will create, as they are more concerned about jobs that get replaced by drones.

The Boucher (2015) study reveals a concern for 'full sky', that drones will be ubiquitous in the sky becoming a nuisance for outdoor life. A concern voices, as the only one apart from privacy, at the first approval round in the Danish parliament by the politician Henning Hyllested from the Danish left wing party Enhedslisten, a party renowned for their critical statements (Folketinget 2016c).

Clothier et al. (2015) study reveals prevailing neutrality from the public toward drones, which they attribute to a lack of knowledge of drones. This neutrality might explain the lack of established pro or anti-civil drone groups in Denmark, our desk research on Facebook, a common space for various groups to organize, did not find any serious public pro or against drone groups, excluding UAS Denmark and other commercial drone pages or groups

exposing positively drones. During the hearing of the drone legislation no organization against drones submitted a response.

Boucher's (2015) study reveals that the public does not feel involved or have any influence on the drone development which concur with our findings in the previous chapter. Effectively approaching public acceptance empirically reveals a different enactment of the drone, possibly a way to reopen and negotiate the dominating singularity push. We observe a less coherent and more personal version of the drone development path, even though effort have been made in the papers to represent some form of coherence of the results. Absent from this empirical version of public acceptance is simplicity, as acceptance becomes personal, based on experience with drones. Absent is abstraction, such as civil rights and regulations, and present is practicality such as an acceptability that correlates with practices with drones that are viewed as beneficial. The public feels powerless, absent in the drone development path we might say, *the story of asking the public*, reveals an externalized public, a public that does not feel represented within the singularity push framework, even though paradoxically the public, in the form of public acceptance, is central to this singularity.

Clothier et al. (2015) study reveals neutrality towards drones, explained by public's pragmatic relation to drones, as many have no experiences and little knowledge about the technology. *This story of inquiry* seems to be unable to include what we call *non-users* as they have not generated an opinion yet. Arguably as drones become more common, more will have experiences with drones, but drones are part of the larger socio-material infrastructure potentially affecting the public's everyday life, as voiced in their worry of full skys. Drawing on Wyatt's (2003) argument that cars are affecting not only car drivers but as well no-car drivers, "*I simultaneously inhabit the same world as car drivers and a different one. My life is affected by cars: as a pedestrian and a cyclist, I see them as a threat to my health and well-being, and as a user of public transport I find that they slow me down*" (Wyatt 2003: 67). There could be argued that non-drone users matter and should be taken into consideration when dealing with the development of civil drones in Denmark, as they arguably are and will be affected by this technology. Wyatt (2003) stresses that often users and producers are in the focus when analyzing technological development and by that a perspective "*in which adoption of new technology is the norm*" (77) is being applied and questions on whether a new technology should be adapted at all to begin with, is not being

asked anymore, why non-users should be included. In the singularity push drones are present, as there is no other reality the question of whether drones should be or not be is ultimately absent.

5.5 The story of creating new collective practices

We have introduced the sport and games practice, this practice could be another source for re-multiplying the singularity push as it can be perceived as a collective practice where the public, as spectators or as directly involved, are engaged with drones. As previously mentioned there is a noticeable growing interest in drone games and are gaining in legitimacy as a sport being soon broadcasted on the international sports channel ESPN. We observe that these collective practices differentiate from the singularity push and *the story of asking the public*, in the absence of the abstraction of envisioning a future with drones, because present are drones practiced directly by the public. This practice unfolds as the public participates as a spectator, an integral part of sports and shows, and some engaging directly with the technology, modifying and adapting it. Drones transform in something tied to a time and occupying a space, they become tangible for the participating public. This practice with drones is collectively negotiated by the participants and viewers, arbeit drone races bears some familiarity to the establish practices of sport. This collective negotiation is what we define as *bottom-up practices* with drones. This practice creates a reality where the public can negotiate and enact a drone that is acceptable to them, unlike the practice that enacts a drone that requires to be accepted, as the singularity push arguably creates (Boucher 2015). Discovering, supporting and investigating the emergence of collective practices could give an insight of the future with drones, the controversies and negotiation in the public. It could be treated as a source of public participation in the drone development path, as Krek (2008) observe*'' Games have the power of involving the citizens in the serious processes without thinking and rationalizing about them''*(683). As public participation in the drone development via the described collective practices is arguably a collateral reality, as it is done unintentionally, we find Krek's (2008) definition *"the power of participation without participation"* (683) quite suiting. The sport and games practice, if the

potential of public participation is utilized, could be an important resource for the development path creation.

6.0 Conclusion: What does it all mean?

In this paper the drone development path creation in Denmark has been investigated by interviewing different actors, participating in and exploring different practices, and performing desk research. We approached the field with an ethnographic multi-sited research design. Multiplicity and performativity are used as tools for a critical analysis of a drone development path creation in Denmark. By engaging with actors and practices we discover how different practices enact different drones. Drones are understood as multiple, but by exploring a few practices we do not state that we have given an exhaustive depiction of what a drone is or could be. What we have is a fractal image as the practices are endless; if we zoom in we discover a complexity equal to one where we zoom out (Law 2008).

As we investigate we discover a limited group of actors dominating the path creation, producing a colonizing practice what we define as a singularity push. The singularity push is constructed in echoing inscriptions and reproduced in interviews and papers. This singularity assumes a drone that is somewhat coherent and consistent, a professional tool containing an undisputed potential for job creation and economic growth and requires public acceptance. Alongside the apparent dominant practices of the singularity push, we find practices that are practiced as local and appear as subordinate realities within the development path creation. These practices appear heterogeneous as nothing universal is being claimed. These subordinate practices could be an important resource for the development path creation but the reality-enacting practice of colonization, the singularity push, appears as destiny, as it reigns unquestioned. Applying a multiplicity perspective opens up the possibility that realities might be different. Examining this singularity push in more detail, we uncover that the undisputed assumption of the potential for jobs and wealth can metaphorical be viewed as the engine pushing the development, as it gives policy makers, the industry and businesses a great deal at stake to exploit this potential. We identify what we argue is a reinforcing mechanism where the drone as a professional tool requires guidelines, legislation, and legislation requires coherence and consistency to be effective.

We find as well strategies at work where empirical understanding of public opinion and public participation are apparently absent in favor of assumption about a coherent and consistent public. This consistency framing is found in the framing of public acceptance

within 3 parameters that through policy and legislation can be adjusted to the effect of acceptance of the technology by the public. Applying a multiplicity perspective on the singularity push, in an effort to re-open the material, we present two stories*; the story of asking the public* and *the story of creating new collective practices*. This is not an exhaustive list of ways to understand and investigate and develop public acceptance within the drone development path, but just examples of the knowledge gains and strategies which can help re-multiply the development path creation, making a *reality that is no longer destiny*. Law (2010) argues that an uncontested reality operates more powerfully, which adhere to the singularity push apparently uncontested and solid, but as we also observe is the fragility of this singularity push that lies in the public acceptance. We have discovered the treat of the single drone accident that could compromise the singularity push and the whole development path. We are not arguing that what we have defined as the singularity push is a fruitless model of action but we argue that by re-multiplying the singularity push, pursuing multiple models, negotiating publicly the hidden controversy of civil drones probably will create a more inclusive development path, albeit apparently more unstable as the controversy is negotiated publicly; an apparent development path that takes subordinate realities into account. The public, expert, users, industry and policy makers could potentially be included, creating an inclusive path. If the dominant practice does not refuse the subordinate heterogeneous practices but included them, a dominant multiplicity, we would not observe a single reality fail or succeed but a continuous, inclusive negotiation until some stability become noticeable.

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7.1 Images and figures

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mg:4.01
Vintage Wings of Canada (2013) The Mother of All Drones. Retrieved 07. June, 2016 from,

http://www.vintagewings.ca/VintageNews/Stories/tabid/116/articleType/ArticleView/articleId/484/The-Mother-of-All-Drones.aspx

Fig:4.02
The total vote result of the drone law in the Danish parliament may 31th 2016. Retrieved 07. June, 2016 from, http://www.ft.dk/samling/20151/lovforslag/l132/104/445/afstemning.htm#dok

Fig:4.03
Scopus (2016) via https://www.scopus.com/

Fig:4.04
Google trends Retrieved 04. June, 2016 from,
https://www.google.com/trends/explore#q=%2Fm%2F0g2bc&geo=DK&cmpt=q&tz=Etc%2FGMT-2

Fig. 4.05 Gephi (The Open Graph Viz Platform) https://gephi.org/about/

Pic 4.06
The students' room with its laboratory equipment (Own picture)

Pic. 4.07
The test room. Sensors are attached to the wall utilised
for indoor flying experiments. A glass window is
separating the test room and the control room (Own picture)

Pic. 4.08
The control room: The drones in the lab are stripped away from the
plastic skin we normally see them wearing.

Pic. 4.09
The picture illustrates how the drones' internal components are literally
kept in a 'black box'- (a curious materialization of Latour' metaphor of 'opening the black box')
(Own picture)

Pic. 4.10
In AAU lab they have developed a catapult where different components of drones can be isolated and tested.
Selliken (2016). *Danske forskere skyder flæskestege med dronekatapult* - for din sikkerheds skyld. Computerworld. Retrieved 21. May 2016 from,

http://www.computerworld.dk/art/236830/danske-forskere-skyder-flaeskestege-med-dronekatapult-for-din-sikkerheds-skyld

Pic. 4.11
The phantom quadcopter belonging to the department of Tinglev (Own picture)

Pic. 4.12 Lifestream pictures sent from the drone. Shown at a screen in the agency vehicle (Own picture)

Pic. 4.13
The drone operator operating the drone at a fire incident (Own picture)

Pic. 4.14
The drone operator is wearing a backpack with a screen (Own picture)

Pic. 4.14
The agency vehicle with a tv- screen streaming pictures from the drone (Own picture)

Pic. 4.15
The view from a drone filming
Østergaard, C (2015) Dansk firma: Her er fremtidens drone-nummerplade. Ingeniøren. Retrieved 06 June, 2016 from,
https://ing.dk/artikel/dansk-firma-her-er-fremtidens-drone-nummerplade-176248

Img. 4.16
The image illustrates that drones are cheap, you can get a drone for free for two month subscription. Illustreret Videnskab (2016). Retrieved 06 June, 2016 from,
http://illvid.dk/tilbud/37154/form/redaktionel/1

Fig. 4.17
Robotics Tomorrow Robotics Tomorrow (2016). Top Three Quadcopter Drone Companies Are From China. Robotics Tomorrow. Retrieved 07 June, 2016 from,
http://www.roboticstomorrow.com/article/2016/01/top-three-quadcopter-drone-companies-are-from-china/7475

Fig: 4.18 Scopus (2016) via https://www.scopus.com/