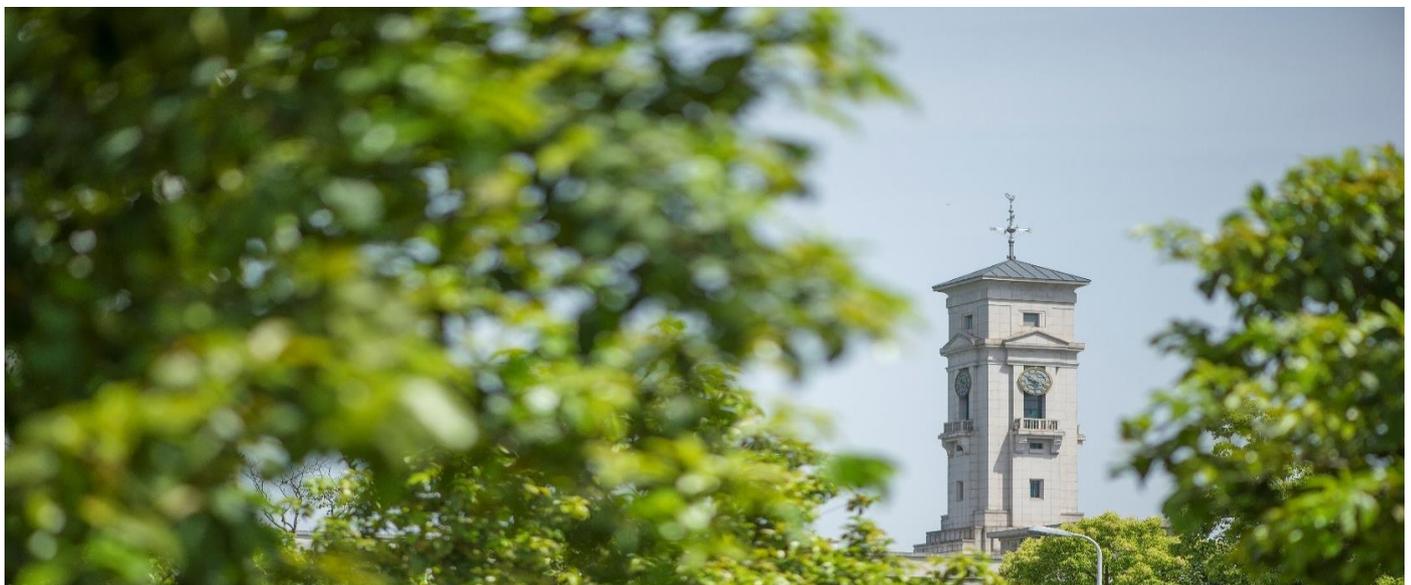


The social construction of the humanitarian health drone: socialising the UAV

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THE SOCIAL CONSTRUCTION OF THE HUMANITARIAN HEALTH DRONE: SOCIALISING THE UAV

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The Social Construction of The Humanitarian Health Drone:

Socialising the UAV

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Abstract

As unmanned aerial vehicles become increasingly present across everyday domains and lives, understanding the social factors driving and shaping the form of these machines gains in urgency. Inspired by socio-philosophical frameworks, this thesis seeks to determine the social drivers and outcomes of this technology, exploring humanitarian health applications in added depth as an empirical example from which future research can derive. A discourse analysis explores recurring themes and phrases from primary and secondary sources which participate in the construction of drone-related narratives, which through the eye of visions and Utopianism can be seen to promote pro-drone conceptualisations of the future. This piece concludes that using a 'visions' framework may help frame narratives and guide balanced and considered regulation for the future.

Keywords: humanitarian health drones; Dingpolitik; utopianism; discourse analysis; visions: social construction; regulation; risk-perception; public consciousness; legitimation.

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Fifth, to Jenny, for your patience and tolerance in these difficult times. To our reunion, may it be as swift as possible.

Finally, to you the reader, a proactive thank you for your patience and interest in braving the seemingly endless.

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I. The Social Construction of The Humanitarian Health Drone: Socialising the UAV

1.1. Introduction

The unmanned aerial vehicle (UAV), also known as an unmanned aircraft system (UAS) or more commonly as a ‘drone’, refers to a class of aircraft which relocates the pilot outside of the vehicle, either through ground-based remote-piloting or automated control through onboard-computers or external robots. While its historical roots can be found as early as WWI, significant developmental improvements since the 1980s-90s have given rise to its modern incarnation –most notably the increased sophistication of cameras, AI, and communications systems (Ruiz Estrada, 2020). Initially designed for the military, the use-cases for drones have rapidly expanded into commercial and civilian fields such as construction, agriculture, aerial photography, and transportation as a result of a significant reduction in overall and comparative costs, and simpler to use (Appendix 1, 88-89; Appendix 2, 108; Appendix 3, 122). One notable driver of this ‘democratisation’ has been the company DJI’s products since the early 2010s, which made the hardware user-friendly, affordable, and consequently brought recreational and civilian drones to a new audience and a new space (Appendix 1, 90; Appendix 4, 140). UAVs can be designed according to necessity and to intended application, thus varying in sizes, capacities, ranges, speeds, and other such technical aspects. This flexibility of design has made them attractive as ‘innovative’ and versatile solutions to contemporary problems.

Drones have emerged as tools for manifold applications, including humanitarian health objectives. Pro-drone discourse envisions a future landscape where these flying objects share the sky with networks of stations for optimised cargo-delivery and everyday normalised usage for hundreds of tasks. This high-tech future is also proposed as the solution to infrastructural problems in the Global South by consumer-facing companies like Matternet, which promote their drone-solutions for the resolution of inequality of access for rural hard-to-reach villages via leapfrogging traditional development stages by adopting cheaper, faster, and lifesaving UAV technologies (Matternet, 2011; Poptech, 2012). Moreover, drone solutions are being proposed for logistical and governance problems caused by the COVID-19 pandemic, with reports of increased adoption

across the globe (WeRobotics, 2020, April 9th; Ruiz Estrada, 2020). The following research analyses this apparent ‘rise’ of drone-based technological humanitarianism, which has heavily emphasised the medical potential of different use-cases, situating it within existing literature and extrapolating the social factors attached to it. Furthermore, the medical applications of today have a bridging effect to the future, as do the discourses and narratives which surround them. The drone, perceived as in its infancy in terms of possibility, is most often understood with an eye to the present and the other to the future. As such, visions and perceptions of the future will be extricated and critically analysed as images of ‘drones for good’ and ‘good drones’ increasingly penetrate public consciousness.

For this paper, *humanitarian* is herein broadly defined as the quest or concern to promote human welfare. Being previously associated with surveillance, asymmetric warfare, and targeted assassinations in the ‘War on Terror’, drones have found a second life in the civilian world with the marketed possibility of facilitating tasks and improving social conditions. Health in this thesis will be inclusive of *public health* and *healthcare*, respectively defined as the “science of protecting and improving the health of people and their communities” (CDC Foundation, 2020) and the “set of services provided by a country or an organization for the treatment of the physically and the mentally ill” (Cambridge Dictionary, 2020). Hereafter, unless otherwise specified, the terms *drone* and *UAV* will be used as shorthand for those civilian and commercial use-case types, and *humanitarian health drones* as ‘HHDs’.

As follows, sources concern both domestic and international applications to have a wider range of evidence and a broader holistic narrative construction. With the advent of the internet and greater global interconnection, perceptions and social constructions can transcend specific levels, and can couple global and micro-local influences in certain contexts. This analysis has attempted to bring together some of these themes.

This paper is but a brief snapshot of a very broad and complex phenomenon, intending to extend existing UAV literature by adding a multidisciplinary layer of analysis. It seeks to investigate the social causes and consequences attached to the humanitarian health drone, its social construction and legitimation online, and the reciprocal influences of and impacts on stakeholders throughout

the process. These questions are narrowed to the HHD as a case study for drone technologies and humanitarian drones. The present research will continue as follows; a literature review will first detail and attempt to summarize the existing wealth of literature surrounding drone technologies. Thereafter, the first chapter will present and outline the social shaping of technology, integrating this conceptual framework into the examination of the construction of the Drone in the public consciousness as influenced by publicly available materials online created by manufacturers, NGOs, organisations, and news media outlets. The aim of this section is to delve deeper into the relationships drones have with society, investigating social, political, and economic synergetic connections whose reciprocal influences cannot be disentangled, and must thus be read and understood as such. The spheres of the technological and the social are not categorically separated but in fact have profound effects on one another, the products of these interactions having causal and consequential results. The final chapter will discuss the implications of the prior findings for the future of humanitarian and healthcare UAVs. Some considerations may facilitate a greater appreciation of the present utility of drones and the unfixed nature of their evolution. The argument here will oppose technological determinism and utopianism, since accepting that technology shapes and is shaped by social factors will allow us to consider that we are capable, and indeed responsible, for setting the regulations and normative limits of the future. The intention is not to make extensive suggestions but to resituate understandings of social control over the future. Critical to this discussion throughout will be ideas of potential, the realized and the near future as a political space as pioneered by sociological academia on utopias.

A global perspective has been taken to be as inclusive as possible of available primary resources. This does inherently incur a certain broadness, but efforts were made to avoid over-generalisation and in fact, lays a foundation for future locality-bound investigations. Further research could build on the outcomes of this thesis through precisely delineated case-studies at different spatial levels for contextual nuance and specificities. Moreover, due to various limitations and timing of the research, the methodology was disrupted. However, an attempt has been made to paint an overall picture of different sources and areas of influence, rather than specific causal links between individual drones, manufacturers, or individual nodes of the actor network. The principle was to predominantly consider available English language resources which may have a participatory influence on public consciousness and perceptions of UAV technologies and their applications.

This leaves obvious gaps for future research by being predominantly focused on the perspectives of digital natives with a working understanding of English. As such, it aims to serve as a foundation and framework for future case studies and critical thought, and findings will almost certainly differ across socio-linguistic contexts.

1.2. Interview Methodology and Reasoning

Contact was made with over forty drone stakeholders across the spectrum of applications, production, and interactions. Four interviews were successfully carried out, and another two were accepted but ultimately could not be carried out. These results are largely expected to be the result of typical response rates, as well as added pandemic-related difficulties which may have affected the response rate. The intention behind this venture had been to acquire the perspectives of different stakeholders to be analysed as part of the discourse analysis and to appreciate different understandings and visions, to open the black box of UAV technologies and collect insider insights. Due to the limited response however, the transcripts were simply analysed for information and expert perspectives rather than serving as a separate generalisable data set. Analysis particularly focused on echoes of mainstream discourses and perspectives which highlighted factors of social construction, regulation, and pro-drone visions of the future, and other information relevant to the featured sections of this thesis. The interviews were semi-structured for pertinence and flexibility and were conducted via online video calling platforms at the interviewee's discretion. Ethical risk was deemed low and approved by the thesis supervisor, and consent and ethics forms were issued to and signed by the participants. Full transcriptions are provided in the appendices as a resource for any future research and for the reader's consideration. The names of the participants have been redacted at the supervisor's request.

II. Literature Review

2.1. Contextualising Military & Humanitarian UAVs

Academia surrounding drones, particularly in IR, focuses predominantly on the military use-cases of UAV technology. Much of this discusses the novelty of asymmetric warfare, infringements of sovereignty, the legality and morality of targeted killings using armed UASs, and the impacts of these new technologies on modern warfare.¹ Most relevantly to the present research, the use of drones in different theatres of war and regions has been linked to post-traumatic stress disorder (PTSD) and mental health problems for those living under the eyes in the sky (Hijazi et al, 2019). This causes geographical limitations for humanitarian applications of drones (Gilman & Easton, 2014), as perspectives and understandings differ according to contexts. This military-oriented literature is further crucial to perceiving the negative images associated with this technology, as the Drone entered Western public consciousness through media coverage of drone strikes and surveillance capabilities. Notwithstanding, there has been a surge of news pieces and research regarding the improvement of living conditions and work efficiency - such as in transportation, commercial deliveries, disaster response and risk reduction, agriculture, policing, and environmental conservation - through UAVs (DJI, 2020; Apvrille, Roudier & Tanzi, 2015; Luterbacher, 2018). Gilman & Easton (2014) explore disaster relief and data collection, while Seguin et al (2018) conclude that UAV deliveries of flotation devices were faster and safer in drowning situations. Malaver et al (2015) experimented on designing a solar-powered UAV for monitoring greenhouse gasses. Risks related to drones have also received academic attention, particularly pertaining to privacy, security, and safety (Yaacoub et al, 2020; Feng et al, 2020; Tatsidou et al, 2019). A short French-language piece by Sandvik & Jumbert (2015, 141) discusses humanitarian drones in the sense of those used in humanitarian missions by states and international organisations for search & rescue operations, emergency aid deliveries, cartographies of crises, and surveillance. More precisely, they argue that the military industry has purposefully sought to

¹ See: Brooks, 2013; Cockburn, 2016; Der Derian, 2009; Malik, 2016; Shaw, 2013, 2016; Weissbach & Tebbe, 2016; Alston, 2011; Anderson, 2011; Charbonneau, 2013; Gurcan, 2013; Iver-Mitra, 2014.

transfer military technologies to civilian and humanitarian applications for manifold reasons, including economic opportunity and more pressingly the improvement of UAVs' commercial image (Ibid, 142). They further describe the rise of start-ups and the expansion of the private sector and non-profit initiatives founded on drone applications which perfectly illustrate the narrative of 'techno-optimism' (Ibid, 146). Albeit short, this piece relates closely to the subject at hand, and will be built upon throughout. Sandvik & Jumbert are not alone in describing various UAV applications emulating military use-cases, such as mountain search & rescue operations (Karaca et al, 2018), small-scale emergency mapping and delivery (Tatsidou et al, 2019), mine-clearance (Habib, 2007), and tracking human traffickers (Gerry, Muraszkiwicz & Vavoula, 2016). Tatsidou et al (2019) also call for the creation of a common international legal framework to establish a shared common language and ethical code to guide the use of humanitarian drones. Ergun et al (2013) further argue that greater humanitarian collaboration is enabled by technology, particularly in terms of data sharing and a reduction of costs for repetitive tasks. Read, Taithe & MacGinty (2016) however caution that data is not knowledge, and that the production of data needs a purpose rather than solely being the objective, unusable and disconnected from action and planning (pp.1315). They describe the beginnings of data-gathering as the underpinning of the modern development of humanitarian rhetoric in the 1860s, despite data acquisition having limited use and return-on-investment (pp.1317). They further posit that the association of technology to humanitarianism, although often seen as a twenty first century phenomenon, actually trails back as far as humanitarianism itself, with each new use of technology being associated to particular political, cultural, and economic imperatives and pressures (pp.1318). The technocratic turn of the third sector, from the 1980s onwards, is a source of the increasing association of data and humanitarianism, technology being attractive for its 'solutions' to everyday strategic and logistical challenges faced by organisations and individuals on the ground (pp.1318-19). Today, technological innovations are central to the political economy where technocratic solutions and quantitative data are favoured to the detriment of other approaches and knowledges, despite these high-tech solutions often being rejected and replaced by low- and no-tech solutions by on-the-ground workers (pp.1320). The findings of Read, Taithe, & MacGinty (2016)'s research suggest that the data-gathering capacities of some humanitarian groups outstrip their actual ability to process the information, and that the push for Big Data processing is part of a modernist process of the 'statistical truth' (pp.1315). This conclusion, directed at an aspect of drone usage, supports

one of the key arguments held by the present research, which is that the modernist technophile approach to problem-solving is increasing the amount of use-cases and drone integrations in professional fields as a result of positive discourse. Belliveau (2016) argues that while UAVs do bring potential for humanitarian application, technology is rarely sufficient on its own when dealing with challenges, creating the risk of over-reliance on technology, and increasingly technocratic and inappropriate paths which remove the human from the humanitarian (pp.304).

2.2. Health-related UAVs

COVID-19 has encouraged the reimagining of drone usage towards healthcare services and public health needs. For example, they have been used to perform tasks in farming (Yang, 2020), and in the policing and surveillance of social distancing (Sinha, 2020; DJI, 2020). Some recent articles have already begun analysing the roles of drones in the current pandemic (Skorup & Haaland, 2020; Anggraeni et al, 2020; Ruiz Estrada, 2020; Angulara et al, 2020; Vaishya et al, 2020; Euchi, 2020; Elavarasan & Pugazhendhi, 2020; Shaw, Kim, & Hua, 2020). Moreover, drones have been used in other epidemics, such as against Malaria by spraying chemicals in rice fields to prevent carrier-mosquitoes from reproducing (DJI, 2020), and were proposed in the 2014 Ebola epidemic as a means of transporting deceased patients without risking further contamination (Emery, 2016). This last reference (Ibid) also discusses drones in a variety of humanitarian contexts, while Hunt et al (2014) propose some considerations for humanitarian health ethics. Many articles investigate the possibility of integrating drones in national public health services, experimenting - with often positive results - for various UAV use-cases, including payload delivery for medical supplies, vaccines, organs, and blood (Anggraeni et al, 2020; Scalea et al, 2019; Wapner, 2016; Haidari et al, 2016; Mesar & King, 2018; Eninger & Johnson, 2015; Amukele et al, 2015), transporting defibrillators for out-of-hospital cardiac arrests (Claesson et al, 2017; Van de Voorde et al, 2017), and emergency deliveries for allergic reactions, opioid overdoses, rabies infections, and diabetic emergencies (McCall, 2019; Ornato et al, 2020). This can be summarised in Bhatt, Pourmand & Sikka (2018)'s conclusion; the application of drones in telemedicine appears to hold promise for increasing the quality and access to healthcare in three categories, identified as prehospital emergency care, expediting laboratory testing, and surveillance. In the surveillance category one can find drones for microbiology and epidemiology to be used in cases of infectious

diseases (Poljak & Sterbenc, 2020; Fornace et al, 2014). Eninger & Johnson (2015) argue for drone's potential for avoiding occupational health hazards. Some directly address the barriers and challenges of medical use-case drones, pointing to intense air traffic and dense infrastructure as obstacles to drones in the US (Graboyes & Coglianesi, 2020), and the legal and practical aspects of using UAVs in emergency situations (Konert, Smereka & Szarpak, 2019). Certain pieces directly seek to convince policymakers and decisionmakers for greater integration of drones (Rothschild, 2020; Church, 2015). Weissbach & Tebbe (2016) describe the burgeoning of the drone market through increasing consolidations, portraying a positive economic evolution. However, others are more wary, cautioning that the label of altruism may be a path to legitimation for military UAV applications through the creation of the 'good drone' image and of a space for UAVs to gain public acceptance (Sandvik & Jumbert, 2015). This idea will be continued in the below analysis. Rosser et al (2018) posit that the evolution of the medical drone has been slower than the maturation of other fields, and that this is due to higher constraints and urgency in clinical situations which do not allow for the proper control of necessary variables. Steps to analyse the logistical necessities and feasibility of UAV implementation in medical contexts have begun, including models for optimal spatial distribution (Pulver & Wei, 2018), analyses of the utility of intra-urban UAS-based emergency responses (Hanna, 2018), multi-objective algorithms for UAV blood supply in emergency situations (Wen, Zhang, & Wong, 2016), managing major incidents via remotely piloted aircraft (Abrahamsen, 2015), and designing decision-making software (Fichleay et al, 2019). Amukele (2020) hypothesizes that the reason for a lack of adoption of drones in the medical field is the yet unknown costs of such an assimilation. Lastly, Laksham (2019)'s SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis of UAVs in public health presents a detailed 'scientific' list and comparison of the characteristics and perceived values of various drone applications. Through a constructionist lens, this type of analysis can be construed as the product of a specific socio-cultural environment. It cannot be truly exhaustive in its explanation of each category by nature and furthermore the value-attribution is inherently biased, even under the proviso of authorial objectivity and research summarisation. Relatedly, several works review the literature on UAVs in medical applications (Rosser et al, 2018; Rosser, Parker & Vignesh, 2018). The present research does not seek to make any such compilation of potential applications and risks but is instead interested in the socio-cultural underpinnings of these beliefs.

2.3. Humanities, Technology, and Theory

Technology is an ambiguous term, which can be defined in a limited ‘hardware’ sense as referring to specific man-made physical objects, but can more inclusively pertain to the activities and knowledge which require and are required to make use of the object, as without know-how the machine is meaningless and unusable (MacKenzie & Wajcman, 1985, 3). It is only through external *knowing* that drones gain a practicable existence. This broad interpretation of what constitutes technology highlights the symbiotic interactions which technology has with the social in its different forms, as the two spheres interact and influence one another. Furthermore, Foley & Wiek’s study of nanotechnology in metropolitan areas (2013) describes a complex network of stakeholders in the daily decision-making process which influences the path of innovation and urban integration. Their findings concluded that when seen through a place-based perspective, places became ‘hubs’ of interaction for the socio-cultural and socio-political forces, and that within these centers actors follow “preconceived mental models of innovation and governance” (p.237), suggesting that the promoters of nanotechnology felt that opponents were impediments to the process of innovation and should not be included in it, a view which the authors found to align with the prevailing doctrines of techno-scientific promise. This purview encapsulates the *modus operandi* of technoscientific governance, which espouses social progress through technological innovation and development. The aforementioned mental models centre on such liberal capitalist ideas as technology push, market-orientation, technology-transfer and closed collaboration, subscribing to the marketability of innovation and economic potential of a product rather than the concerns of potentially limiting and contradictory stakeholders, such as non-profit advocacy organisations or environmental groups (Ibid, 237, 244). Such concepts are indeed the speculated sources of the repurposing of military UAV technology to humanitarian practices (Sandvik & Lohne, 2013).

There is a sense today of being at a technological crossroads, with high expectations for rapid socio-technological change in the near future. Brynjolfsson & McAfee (2016)’s *The Second Machine Age* posits that the effects wrought by today’s advances in digital technologies are comparable to those brought by the steam engine and the Industrial Revolution, and consequently that we have entered a second era of great change which they predict will bring hugely beneficial

transformations and difficult new issues. Schwab (2016) goes further to argue that the present is in fact the fourth Industrial Revolution in terms of the speed and scope of technological systemic impacts, and that UAVs are representative - amongst many other technologies - of this era. He argues that the increased speed of change will necessitate changes to styles of governance to be more “agile” in their responses to avoid being overwhelmed. Indeed, Weiss (2005) makes the case that issues related to technology are at the top of the agenda for global governance in terms of international norms and behaviours, particularly as they increasingly encroach on traditional international relations concepts, such as sovereignty, competition and dependency, and military power. There is plenty of academia concerning these subjects about military drones, however the non-military domains have yet to acquire such a vast body of research.² The products of the increasing association of technology and science (MacKenzie & Wajcman, 1985, 9) are exemplified by the medical applications of drones, and indeed there is a sense of expectation for soon-to-be technologically driven socio-cultural change.

The social shaping of technology (SST) has however received more attention. This strand of research seeks to open the ‘black box’ of technology to better grasp the socio-economic patterns embedded in innovation processes and the content of technology, in doing so going against the post-Enlightenment ‘technological determinism’ which does not problematise technological change (Williams & Edge, 1996, 866). Technological determinism holds that technology is an independent factor and that technological change causes social change for the better, arguing that it is in fact the strongest driver of change (MacKenzie & Wajcman, 1985, 4). The central concept is that of ‘choices’ intrinsic to each aspect and step of development and application, opposing the uncritical belief that technological change is somehow driven by itself, a series of linear logical successions outside of human intervention and conscious choices (Ibid, 866). This framework is not solely academic but engages policy making and objectives, seeking to dismantle simplistic models and obscured perceptions to encourage more pro-active technology policy agendas which explore the possible implications of different choices within and during technological processes of development (Ibid, 867). Using the concept of social ‘shaping’ rather than ‘construction’ to avoid

² See the above listed examples of military drone academia on pp.11.

debates about Reality outside of the socially contingent, the SST in simple terms holds that social relations influence technology, and artefacts have an impact on the social world, this reciprocity informing innovation (MacKenzie & Wajcman, 1999). In particular, the negotiability of technology is central to SST, as various groups and forces impact the forms of technology to their own ends and influences the possibility of different future designs and outcomes (Williams & Edge, 1996, 867). The irreversibility of development is also questioned, pertaining to the choices which may be foreclosed as a result of past decisions, depending on the nature of an innovation's socio-technical environment and its past shaping. For example, certain features may become entrenched whereas others remain negotiable, or when solutions become locked-in by economies of scale. As such, innovation can be seen as a sociotechnical process due to its social, economic, and societal drivers outside of technical possibility, which can lead in socially desirable and undesirable directions (Maclaine Pont, van Est & Deuten, 2016, 8). The consensus in SST is that regulation needs to move past 'reactionary' and 'adaptive' processes to proactive investigations and regulations, as the rules of the present participate in innovation dynamics (Ibid, 12; Williams & Edge, 1996, 867). The present research supports such an approach to regulation by outlining the systems which determine visions of the future and support processes of critical interrogation for applications and legislation.

This review of the literature covering drones and technology in broader terms presents some of the current conclusions and research areas of academia, as well as existing analytical frameworks. As shown, some cover aspects to be seen in this present discussion, but the overall subject of social construction of HHDs have not, to the author's knowledge, been addressed in peer-reviewed literature. The writings of Kristin B. Sandvik, particularly (Sandvik & Jumbert, 2015; Sandvik, 2015), have been inspirational and are closely related to the findings of the present research.

III. Reimagining Drones: Constructed Understandings

A simple illustration of the social construction of understanding and ‘potential’ can be illustrated in the global handling of the environmental crisis - a purely consequentialist approach seeking immediate momentous results would prohibit fossil-fuel vehicles, restrict electricity to renewable sources, and limit water consumption per person. This is *a* solution to the problem, but would most likely be considered infeasible, requiring environmental regulation to be incremental and long-term, founded in understandings of what is possible and politically viable. The same can be said for technology – facts are not at the heart of innovation - socially constructed understandings of facts are. This is important distinction opposes technological determinism to instil an appreciation of the factors which shape and are shaped by technology. Indeed, technology is susceptible to the influences of its great many and varied interconnections, such as those of politics and the “coalitions of interests” which affect development and implementation (Lambright in Peckham & Sinha, 2017, 34). Moreover, technology is also susceptible to the public’s and the policymaker’s understandings of risk, which are embedded in ‘risk-belief systems’ that nebulously contain, are larger than, and yet are contingent upon, individual belief (Zhu, Pasch & Bergstrom, 2020, 2). This is not the only factor shaping the developmental process for drones; pre-existing technologies are also a condition and active shaping force for technological evolution, and are largely determinant for innovation as this is for the most part a process of modification of existing knowledge (MacKenzie & Wajcman, 1985, 11). Thus, technological advancement is more of an incremental and painstaking graduality than by leaps of genius by ‘great inventors’, the latter of which is an understanding proposed in certain histories of technology (Hughes, 1983 in MacKenzie & Wajcman, 1985, 10). Applied to UAVs, this means that existing technologies and applications shape any potential new ones, and that developments will occur progressively as time passes. The metaphor used in one of the interviews described the process as climbing stairs, which occasionally succeed in opening a new floor of opportunities (Appendix 1, 92).

This incrementality is conditioned by imaginative understandings of the possible, which are themselves embedded in social factors. This is best understood in the sociological frameworks of the Utopian pioneered by Ernst Bloch’s trilogy *The Principle of Hope* (1954, 1955, 1959). Deeply embedded in Marxist assumptions of endless revolutions inciting transitional progress, he details

the *Not-Yet-Conscious* and the *Not-Yet-Become*, concepts rooted in Hope as a fundamental aspect of social life. He explicitly detaches Utopias from Utopianism, the former being expressions of desire that he deems to be “pipe dreams” for being pointless abstractions, while the latter is an intrinsic part of the human condition wherein people situate themselves in the future through a continuously experienced Hope (Ashcroft, 2012, 4). Indeed, in Blochian terminology, Utopia is not reliant on a physical manifestation, but is instead an anticipatory impulse of what could be within the limits of human consciousness, hence the *Not-Yet-Become*. He supports that *Vorschein*, ‘anticipatory consciousness’, is the *raison d’être* of art and literature, and thus participate heavily in Utopian production as the *Vorschein* clarifies the possibilities of rearranging social and political relations which in turn produces the *Heimat*, ‘Home’, a site of transformation and generation of the Utopian idea (Ashcroft, 2012, 12). Indeed, Utopia, further described as “social dreaming” (Sargent, 2010) and “expressions of desire for a better way of being” (Levitas, 1990), fundamentally answer the universal human experience of lack as a synthesis of reason and passion (Bloch in Hardy, 2012, 129). Drones can be integrated into this framework; the parallels between the *Not-Yet-Become* and technological development are evident, as both are procedural, never-ending, and perceived as ‘a step forward’, as even failure provides a lesson and concrete intermediary or minute successes and changes. Moreover, innovation is limited to the *Not-Yet-Become*, and progressively extends the network of choices and possibility into the *Not-Yet-Conscious*, where previous decisions influence the shape this takes. Further, Dierkes, Hoffmann & Marz (1996, 14) devised their modelling of ‘visions of technology’ as split between two levels for individuals, the external comprising interpersonal communications and cooperation and the internal being focused on individual patterns at the cognitive level of decision-making, behaving, and strategizing. Technical innovations are contingent on a given network and are imagined in the *Not-Yet* through visions, *Leitbilds*, which combine the abstract and the concrete to conceptualise a ‘vision’ of a desirable future, understood but technically imprecise, which guides individuals and groups in the initial phases of development (Ibid, 18, 20-21). The difference between utopianism and *leitbilds* is the relation to the future; *leitbilds* function in the possible near-future, whereas utopianism looks to a usually radical change, but possible in a longer-term scale. Both reflect the imaginations of the participants, and the ‘contributive’ value of each is in their function as guides and influences on present actions seeking to make a change. Visions and utopianism are useful frameworks for analysing drones as conceptualisations of the future can be outlined, deconstructed,

and categorised through idealisations of particular pathways of development and integration. The reciprocal interactions between vision and innovation condition the forms drones take and the applications they are given. Thus, drone deployments must be construed not as the product of technical ability alone, but also as contingent on social factors and embedded in particular visions for the near- and long-term future. Determining what forms these take, inclusive of the narratives which support them, is an aid to informed, critical, and proactive regulation which will circumvent technological somnambulism into potentially undesirable situations and create healthy debate. For HHDs, the visions created posit feasibility in fleets of drones working in national networks, performing deliveries, emergency interventions, specimen and organ transportation, and health surveillance through high-tech sensors and automated systems. These visions are embedded in the ideology of technological utopianism, or as Sandvik (2015, 77) denominates it, “drone utopianism”; as will be shown, UAVs are rhetorically placed in the latter at the centre of pro-drone discourses envisioning drone solutionism replacing politics for numerous systemic problems like inequality and moral injustice, both as a measure of control for the risks and uncertainties of the present and the future. Therefore, the framework of utopianism and visions works both to analyse what is being imagined, how it is perceived, and the discourses which legitimate such perceptions. The next chapter will try to find the sources of this narrative, but it can already be seen as embedded in technophile utopianism, where progress is equated to higher societal assimilations of technology.

3.1. Apolitical Husks?

Some contend that the Object, or artefact, is but a tool, an apolitical husk. It is not in it of itself imbued with intentions, obligations, and ethical coercions. It is only through action that it becomes politicised (Mackenzie & Wajcman, 1985, 26). This is disputed by those who believe technology to embody social interactions and a specific set of ethical commitments imbued by those stakeholders involved in its conception, innovation, production, and sale. This serves as a starting point for socialising the Drone, as it can be embedded within critical theories on technology and innovation based on presumptions of social embeddedness. Herrera (2003, 560) argues that technology is inherently political in two ways, the first being that the construction process is subject to politicised debates and contestation, which may affect technological trajectories, while the second is the more abstract embedding of artefacts in particular practical

knowledges and institutions of management. Let us situate the drone within this framework, first from the philosophical angle. The humanitarian drone, despite being its own artefact family/category, is often associated with its military forebears and cousins. The similarity in composition and linguistic denomination arguably contribute to the association, despite the differences in purposes. The military use-cases shape perceptions of humanitarian drones by creating a socio-cultural context of meanings and understandings which are attached to the Machine. For example, people living in the FATA region of Pakistan, Syria, Iraq, Afghanistan, and Somalia that have been under the watchful eye of a Reaper or Predator drone will have personal perceptions of UAVs and their own fears (Hijazi et al, 2019). Dingpolitik posits that each object can generate different patterns of emotions, disruptions of the status quo, debates, and attached issues (Latour, 2006). It further gives insights on how artefacts concentrate, catalyse, and become politicised, involved in disputes where there is no 'Truth' available, there are no facts outside of the different represented perspectives (Walters, 2014). The Object thus becomes the focus of public debate in mediated ways, caught up in discursive practices (Walters, 2014). Armed drones have been created in public knowledge through multiple narratives, including that of 'clean' warfare (Sandvik & Lohne, 2014) and 'technofetishism' (Parks & Kaplan, 2017; Graham & Shaw, 2012), the latter of which is supported by the White House (Shaw, 2013) and arms-industry lobbyists (Shaw, 2013; Cockburn, 2016), which constructs techno-centred visions of future warfare as an unstoppable evolution of the present. Most crucially to the argument, the various ideas, images, representations, narratives, political discourses, and perceptions which surround the Drone as a politicised artefact are not exclusive to particular use-cases or intended purpose and are not necessarily cohesive, thought-out, and carefully and critically categorized interpretations of the Object. Thus, there are interactions and bleedings between the images of the military and commercial, the armed and the humanitarian. In forums of debate for "matters-of-concern" where convincing appeals to 'fact' are unavailable, as is the case with emerging UAV technologies, consensus is hard to achieve and technologies may become embedded in personal understandings and risk-assessments (Latour, 2006). As such, the discursive repercussions of targeted assassinations in Pakistan, Yemen, or Afghanistan, as long as they successfully escape the fog of war to penetrate public consciousnesses, are not divorced from the images of police drones or humanitarian ones but enter the nebulous amalgamation of ideas attached to the Machine, hence the controversy surrounding the use of drone targeted killings (Andrade, 2013). They intertwine

in the creation of ‘visions’ of the future. Indeed, Drones and UAVs are terms which are so broad, encapsulating such a variety of technology, techniques, required skill-sets, and capacities, that it must be specified that it is in fact not the individual machine which necessarily invokes mediated images but the ideas which it represents. Moreover, the data produced by drones is also politicised and constructed despite its ‘scientific’ surface appearance (Read, Taithe & MacGinty, 2016, 1320). The drone artefact is therefore embedded and imbued with political associations, connotations, and environments.

The concrete politicization of the drone can also be seen in its replication and perpetuation of existing systems, inequalities, and debates. For example, issues related to ‘data colonialism’ (Couldry & Mejias, 2019) and privacy are not exclusive to drones, but part of larger contemporary debates surrounding Information and Communication Technologies (ICTs), social media, and modern governance. Here, ‘colonialism’ describes the imposition of new Eurocentric visions of knowledge and rationality, whose consequence is the reconfiguration of relations configured around this new understanding. Moreover, the construction of experimental networks by Zipline and Matternet in Africa, both Silicon Valley based companies, are informed by existing political environments in the Global North, where drone usage is heavily regulated and perceived as underdeveloped and risky whereas Africa is constituted, through perceptions of need and opportunity, as a better field for product development (Sandvik, 2015, 75). Both of these for-profit companies operate health-related UAV cargo deliveries for blood, medicine, and vaccines (Matternet, 2011; Andrade, 2013), health interventions which seek to demonstrate their visions of drone-based possibilities and futures, and create the ‘good drone’ image through a first wave of experimental social missions, with the intention of bridging to expansion and commercial applications in the future (Andrade, 2013; George, 2017). There can therefore be economic incentives to the deployment of HHDs, situated in the present and in forward-looking strategies. Moreover, the decision to deploy humanitarian drones in Africa is informed by perceptions of the continent as a space for “good drone interventionism” and in constant need for external aid and ‘rescue’ by outsiders, and is thus informed by and supports a convergence of factors including historical legacy of colonial and post-colonial governance, the modern humanitarian emergency zone, and Africa as an ‘emerging market’ (Sandvik, 2015, 74, 75). These perceptions allow for the tangible social shaping of HHD deployment strategy and necessity narrative.

As such, UAVs are demonstrably politicised and socially shaped, and not simply apolitical tools. Moreover, the production and deployment of HHDs is informed by perceptions of need, opportunity, potential, and influenced by contextual conditions. The HHD is interrelated with military applications in popular understanding, regardless of differences in system architectures and purposes, being conjoined through the perceived similarity of the two objects in public consciousness. Concretely, the perceptions of the HHD and its practicability are also governed by interactions with other individual and collective assumptions and understandings.

3.2. Stakeholders

3.2.1. States

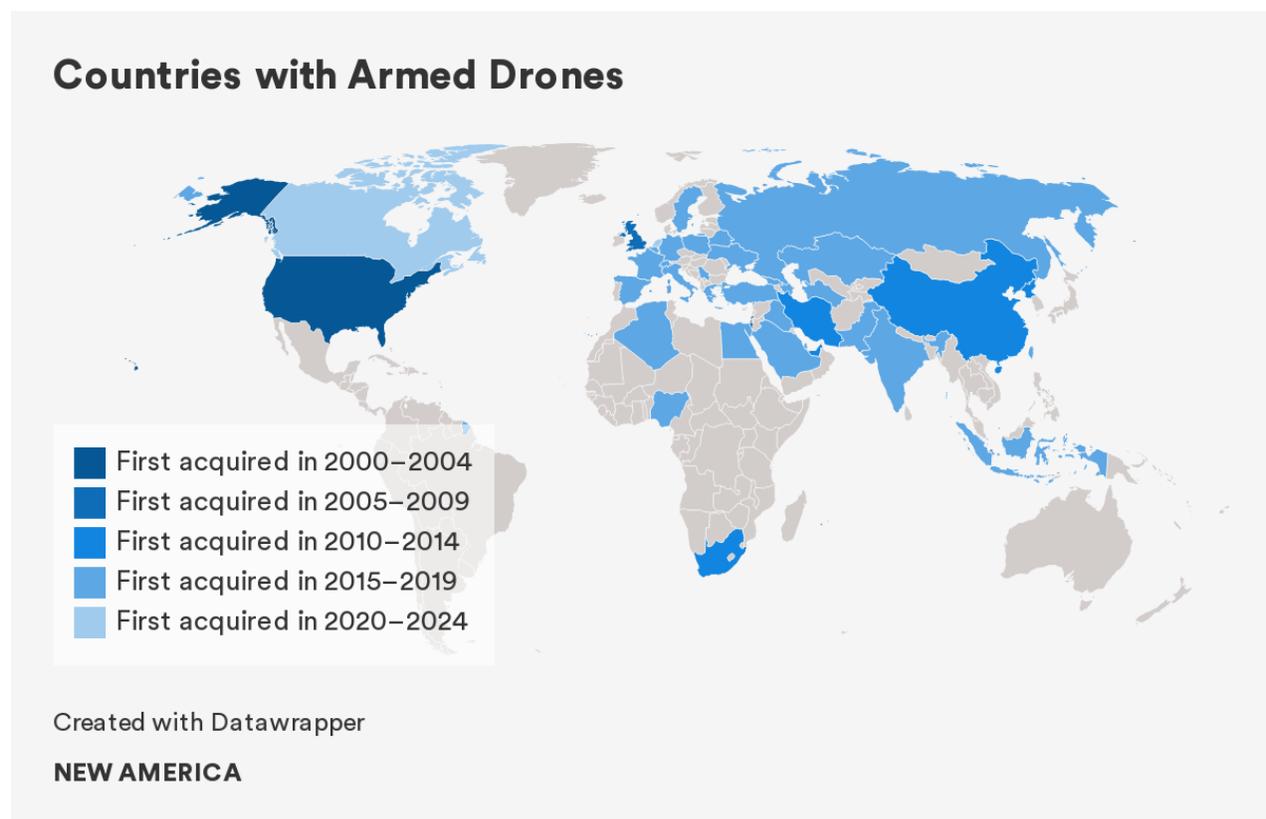


Figure 1 - Coloured Map of the Countries Which Acquired Armed Drones & the Period of Acquisition. Produced by New America in 2020. Found on <https://www.newamerica.org/international-security/reports/world-drones/who-has-what-countries-with-armed-drones/>.

The state shaping of technology cannot be separated from the economic shaping of technology (Mackenzie & Wajcman, 1985, 21). Accordingly, in the United Kingdom, there has been an explicit campaign to change the image of the drone in public consciousness, going as far as to seek to separate new systems from the very word ‘Drone’ to reconfigure perceptions of UAVs to allow deployments in the domestic airspace (Gallagher, 2012; Sandvik & Jumbert, 2015; Bennett-Jones, 2014). The lexical struggle is down to a desire to remove the military connotations of the technology, often associated to the drone strikes and targeted killings of Predator drones, hence the adoption of more neutral terms such as unmanned aerial systems (UAS) and unmanned aerial vehicles (UAV) by the industry (Gallagher, 2012). Indeed, the UK has been one of the earliest adopters of armed UAVs after the US and has also been confirmed to have used General Atomics’ MQ-9 Reaper for missile strikes outside of its borders (New America, n.d.; Drone Wars, 2020). The legal status of drone strikes is still unclear under international law, and the killing of one’s own citizens abroad is even more so, despite the UK and the US both having done so (New America Foundation, 2020). Certain groups, such as the Unmanned Aerial Vehicle Systems Association (UAVSA) and Astraea have sought to influence public perceptions of drones, supported by the British police and Ministry of Defense’s interest in drone applications, including law enforcement, border patrol, firefighting, and road traffic monitoring (Gallagher, 2012). These consortiums of military and industry manufacturers also received public funding for this reconfiguration of perceptions to allay fears of spying and ‘Big Brother’ governance to more a patriotic acceptance of the “national mission” (Ibid). As an early adopter of military drones, it seems evident that the British government should take such an active role in the public debate surrounding a controversial technology which they are seeking to further integrate at home. The appellative change is part of this reframing; whereas many military systems took on fearsome names such as ‘Reaper’ and ‘Predator’, the choice of ‘Watchkeeper’ for the newly developed machines was a choice in the wake of the controversy of targeted killings. This linguistic slight-of-hand also appears in the rebranding of the *Protector* drone for public relations purposes (Rogers, 2019). Reframing the names and marketing language away from violence to defensive surveillance and the national mission negates or subverts a level of public suspicion. Although the example here draws on the case of the UK, it can be argued that any drone-owner states have a vested interest in legitimising the use of drones for state purposes, especially in democracies wherein a backlash could prove politically disastrous because of the secretive, hands-off tactics permitted by

UAVs. Thus, HHDs are firmly embedded within a given socio-political environment, and stand to legitimate greater assimilation of drone technologies in popular visions through close-range civilian-drone interactions and deployments. Further, the encouragement of further State ownership and control of domestic-deployment health drones, as would likely be the case in a nationally-funded health service in the UK, would likely cement the place of military use-case drones as it would reinforce the narrative of ‘inevitable drone proliferation’.

Moreover, as seen through the framework of foreign aid theory (Pankaj, 2005) the international state-controlled humanitarian deployment of drones would be politically interest driven, rather than a purely philanthropic mission. As such, even in the context of an epidemic or any health-related issue which is not intrinsically political, the Drone and its operation would be politicised by the interests and official and unofficial objectives motivating their ‘humanitarian’ deployment. The knowledge transfer of drone technologies from the military sphere to private and humanitarian today includes drone-equipped states as active stakeholders, as there is an inherent interest in legitimisation of drone surveillance and usage for domestic law enforcement. As made evident during the COVID-19 pandemic, many countries have resorted to drones to enforce public health security measures such as minimized individual movements and wearing facemasks in public spaces (DJI, [2020], 2020; Lane, 2020; Sinha, 2020; Ruiz Estrada, 2020; Jakhar, 2020; DroneBlogger, 2020). Without debating the legitimacy of such applications, successful deployments will influence perceptions of technological and practical potential, thus directly contributing to the shaping of future use-cases and legitimate applications. Moreover, there is an argument that certain kinds of technology create and fix certain sets of social conditions as operating environments (Mackenzie & Wajcman, 1985, 31). That is to mean there is a debate for example as to whether certain political configurations are preconditions for other forms of technology. The HHD is arguably a product of technoscientific governance, made possible by liberal capitalist visions of profitable and marketable innovation, as they combine the profit-oriented development of technologically sourced social progress. Indeed, Read, Taithe & MacGinty (2016, 1315) argue that data technologies including drones tend to operate to reproduce neoliberal logics and asymmetrical power relations in humanitarianism. Moreover, UAVs are arguably of little use without certain concurrent devices, software, skills, and infrastructure – they rely on a set of conditions – such as being on the connected side of the Digital Divide - to operate

at full capacity and potential. Without this, they lose their operational value. For example, without a computer, be that a PC or smartphone, the data and video collected by drones could not be communicated or utilised. Logically, this indicates that there are appropriate and inappropriate contexts for applications. The concept of ‘technological fix’ or ‘solutionism’ describes the attempt to resolve problems through engineering, often the result of externalities caused by prior technologies. These are often short-term economical processes which are antonymous to ‘structural fixes’, meaning the solving of problems by resolving underlying environmental, institutional, and structural issues. Armed UAV research views drone strikes as short-sighted ‘fixes’ which both prevent and undercut long-term attempts to address the roots of violence and fundamentalism, often in fact further radicalising the disadvantaged in asymmetric warfare (Cockburn, 2016). Advocacy groups uphold this line of argument, particularly as the costs of war increasingly incur civilian ‘collateral’ victims (DroneWars, 2020). The ‘technological fix’ concept can also be argued for HHDs; in a response to a blog post by Inveneo (Inveneo, 2014) exploring four ways ICTs could be used in the Ebola epidemic, humanitarian worker Timmo Luege (2014) countered the manufacturer’s proposals of using drones to airlift medicine and supplies to villages, arguing that due to technical and practical limitations, motorbike-based deliveries would probably be more logistically reasonable, and in fact asked what the drone would even deliver, considering the only treatment was to give intravenous liquids to control fevers and blood pressure. He goes on to point out who the drugs would be sent to, as directing parcels to individual families only raises more logistical questions, and to hospitals and medical centers seems unnecessary as a larger vehicle would be a more appropriate use of resources. Luege finishes by arguing that logistical medicine deliveries to remote areas are not the challenge facing decision-makers but rather the systematic identification of infected and their contact networks and effective quarantine procedures and the challenges of intra-urban transmission. In this example, drones are inappropriately suggested as a technological fix to a larger problem. Another example is the suggestion of ‘mortuary robots’ for the infected deceased, which rings of cultural insensitivity, questionable ethicality, and could also have had counterproductive effects in terms of controlling the outbreak (Emery, 2016). The many new COVID-19 related use-cases for drones also of limited empirical added-value, with many applications being of unclear utility, and mainly intended to increase drone integration (WeRobotics, 2020, April 9th). For such inappropriate suggestions, several causes can be given. The first is a lack of field experience and hands-on knowledge, which

causes oversights and misinformed assessments of possibilities, problem-solving, and at times even the problem-at-hand. Secondly, the economic motivator behind a push for increased drone use-cases exacerbates the knowledge gaps, as the fundamental drives for the industry are profit and marketing of a product rather than making the most suitable machine for specific humanitarian practices. Even with the best intentions, a business must be profit-oriented to survive. Thirdly, the techno-utopian undercurrent in assumption of the utility of technology in every situation further incites inappropriate ‘technological fix’ solutions and can mislead decision-making with idealistic propositions. The attractiveness of sleek futuristic promises for solutions to a problem in the public eye is appealing, at times proposing an immediate or short-term remedy rather than longer-term more arduous systemic fixes.

3.2.2. Industry

The predominant source of promotion for greater drone usage, the UAV industry is composed of a diverse range of manufacturers and end-users of different sizes, recognition, financial objectives, scale of operations, and so on. DJI Enterprise, Parrot, Zipline, and Matternet are regularly designated as the high-profile ‘key players’, with the largest operations and/or mainstream attention, particularly as use-cases increasingly pertain to the civilian and professional realms (Appendix 1, 85, 90, 92; Appendix 2, 103, 111; Appendix 3, 121; Appendix 4, 133, 135). These have survived the high failure rate in the market (Appendix 4, 135), and are strongly attached to the Drone’s ‘idea nebulae’ through regular association in diverse media. Through the HHD, certain patterns of inequality and marginalisation are reproduced by profit-driven operations; in the case of Zipline and Matternet in Africa, the justification and marketing for these operations rely on philanthropic narratives of progress and development, despite their business models requiring high frequency, high volume routes for profitable returns-on-investment, a commercial necessity which undercuts the access of all to this technology by focusing operations on lucrative areas (George, 2017; Berkley, 2016; Burrows, 2015; Matternet, 2011; WeRobotics, 2020, March 25th). As such, patterns of unequal distribution of resources and healthcare services are reinforced by for-profit operations which can find little commercial interest in serving the most marginalised. Importantly, those within the UAS industry, vested with financial interests, are obvious stakeholders of the Drone, and the foremost responsible for the integration of individual and collective biases within

the artefact itself. As such, there is a concentration of power within the manufacturer and producer of drones and drone related products through the influences they effect, consciously or unconsciously, in architectural shaping, deployment, business modelling, motivations, and social environments and impacts. Their materials, including promotional videos, articles, and tweets, seek to generate hype for the potential of drones, bemoan regulatory restrictions, make promises of safety and opportunity, and create the foundation for dronified visions of the future.³ These concentrated efforts to direct the narrative constitute drone utopianism and proactively seek to influence current understandings and visions in an operation to bridge current and future commercial opportunities - unpacking this narrative construction will follow in the next chapter. Finally, these direct efforts to influence perceptions by companies depend on access to audiences and mainstream attention, something which favours the larger, more visible, and more profitable organisations will have a greater ease in. Hence, the influences of larger globe-spanning companies may be felt more strongly than those of smaller local ones.

3.2.3. *NGOs*

NGOs are stakeholders in the construction of drones, participating in the social shaping of drones. WeRobotics, a not-for-profit drone operating and manufacturing organisation, takes exception to the reinforcement of the Digital Divide and existing structural inequalities by for-profit operations which neglect marginalised populations which do not fit the drone companies' business models (WeRobotics, 2020, February 13th), and promote ethical, local, and impactful drone applications which explicitly add value in considered ways to operations and communities, as exemplified in their analysis of the different reported 'innovative' use-cases related to the COVID-19 pandemic (WeRobotics, 2020, April 9th). It also participates in the discussion and construction of the HHD through its blog posts.⁴ It also contributed heavily to the Humanitarian UAV Network (UAViators)

³ See: DJI, 2015: 2019: 2020: [2020]; Wing Medium, 2019; Inveneo, 2014; iHLS, 2014; Ledgard, 2014; SPI, 2014; Matternet, 2011; Poptech, 2012; Draganfly, 2020; DroneBlogger, 2020; Elite Consulting Inc, 2020; TED, 2017; Vayu, 2016; Pix4D, 2015.

⁴ See: WeRobotics, 2017, June 12th: 2017, October 18th: 2018, January 8th: 2018, April 19th: 2018, December 13th: 2019, February 25th: 2019, October 9th: 2020, April 6th: 2020, April 9th: 2020, August 26th: 2020, March 25th: n.d.

Humanitarian UAV Code of Conduct, a set of principled guidelines for operators in humanitarian settings or missions (Humanitarian UAV Network, 2016). This technophile humanitarianism lends credence to the moral economy of the ‘good drone’, altruistic use-cases appearing to support the notion that drones can be used for good. As such, through their communications and activities, NGOs participate in the shaping of social understandings of the Drone, and normatively influence UAVs by legitimating certain applications, proposing ‘correct’ methods of deployment and by consequence supporting a specific image, all of which are associated to the Drone’s idea nebulae.

3.2.4. Individuals

Individuals are also stakeholders and play a part in the shaping of drone technology. This can be in such capacities as engineering, political and regulatory facilitators, personally influencing the technological pathway and encouraging certain ways forward. Interviewee 4 (Appendix 4, 136) spoke of Paul Kagame being instrumental to Zipline’s contracting and establishment in Rwanda.⁵ Moreover, individuals, through interactions with the technology, participate in its social shaping. Fears and risk-perception influence design and deployment, acceptance engenders greater application, misgivings may lead to backlash and regulatory consequences. Individual agency cannot be stripped from drone understandings and must be situated as parts of collective perceptions. Social environments across localities determine HHD implementation, as acceptance involves contextual factors such as digital nativity, prior understandings of drone technology, understandings and acceptance of the commitments made by drone operators to name but a few. The possibility of drone integration, with the normative stipulation of public acceptance, necessitates positive associations to the artefact. Localisation of drone technology and expertise draws the social shaping of the drone to the community, and away from large generic machines to allow for flexible, appropriate, and reflexive approaches to health-drone applications. This furthermore ‘decolonises’ the UAV’s production through meaningful participation and equal partnerships by limiting or eliminating foreign dependencies and social influences on the drone and its applications by individuals who are unaware of local complexities, needs, and social

⁵ This was also stated by CEO Keller Rinaudo himself (TED, 2017).

conditions (Hillhorst, 2020; WeRobotics, 2020, February 13th). Individual thus reciprocally shape HHDs both in understandings and concrete social relations.

3.3. Chapter Conclusion

This chapter has shown that HHDs are influenced at every stakeholder level in the perceptions and shaped through this social interaction. This interaction is two-way, as the technology participates in, reproduces, and can also initiate change in social systems and relations. It is thus constructed by and constructs the environments in which it is created and deployed. The next chapter will examine more closely the different discourses which support drone integration through thematic analysis.

IV. Discourse Analysis

An analysis of a variety of sources reveals recurring themes and perceptions relating to humanitarian UAVs in their diverse applications, chiefly in discussions of health-related applications. Herein, evidence is primarily drawn from media like news, blogs, NGO publications, conference papers, industry and manufacturer materials and marketing, Twitter, and videos, the connecting thread being that they are all freely available online. This means that they have potentially wide audiences and are easily accessed. Sifting through internet sources allows for the deconstruction of narratives which present drones to wide audiences in public forums and the outlining of drone-based visions which encourage greater assimilation of UAS technologies.

4.1. Lifesaving

Most present thematically across the different sources was the belief that drones are ‘lifesaving’, sometimes stated in variations such as ‘saving lives’.⁶ Although most often explicitly stated as ‘lifesaving’, the concept is sometimes more implicit to the argument or presentation (UNICEF, 2016; WeRobotics, n.d.), or presented as a ‘life changing’ improvement of living conditions (McNeil, 2018). It is heavily incorporated in narratives of the dronified future and presented as a self-evident fact. Used as an adjective or an action phrase, the idea asserts that UAVs *would*, and indeed *will* save an extensive number of lives. Considered in this light of ‘lifesaving technology’, an out-of-hand dismissal is harder as the debate is given a moral dimension. Further, this assumption that increasingly complex and integrated technology is inherently a means to save lives participates in technological utopianism. Moreover, this recurring absence of empirical argumentation in the rhetoric of blogs, manufacturer websites, and news media removes the dialogue from the subject; it is not a space for discussion of the future, but an affirmation of a yet-to-be proven perspective. In short, opinion is stated in a manner-of-fact way which insinuates validity, supports the marketability of drones, and reinforces a technologically deterministic and

⁶ For examples, see following; George, 2017; Wright, 2015; Vaishya et al, 2020; Boutin, 2018; WHO, 2019; Chan, 2016; DJI, 2019; DroneBlogger, 2020; Chow, 2012; Ledgard, 2014; Draganfly, 2020; Smedley, 2015; TED, 2017; CNN Business, 2016; WIRED, 2017; TIME, 2018.

utopian discourse which posits that new technology encourages the best aspects of human nature and inevitably positively progresses.⁷ This recurring theme is also present in academia.⁸ Uncritical or speculative repetition of the ‘lifesaving’ quality of drones in primary and secondary literature shapes the discourse around UAVs by asserting a *probability* as a *tested fact*, thus legitimising the statement, and by proxy the machine, and disconnecting the issue from further questioning. It also influences the way that drones are understood and perceived; repetition may appear as validation and is likely to penetrate public consciousness by consequence. The acceptance and depth of this awareness and acceptance however is uncertain. In the context of COVID-19, some have sought to draw on the crisis for marketing material as has DJI Enterprise ([2020]; 2020), participating in the hashtag #DronesForGood. An example of the ‘lifesaving’ discourse is in a blog post on DroneNews.Africa (DroneBlogger, 2020) discussing the operations of CharisUAS in Rwanda. The phrase is used in relation to the company Zipline’s blood-delivery operations, also in Rwanda. Zipline’s activities have received a lot of attention as they are one of the few examples to have been widely and systemically implemented, both in public health and in payload delivery (WHO, 2019; Berkley, 2016; George, 2017; McCall, 2019; McNeill, 2018). Arguably, Zipline’s clout comes from exemplifying what drone delivery networks for the national level could resemble, a seemingly successful model which serves as a prime example for drone-optimists. Being a for-profit company, their business model is attractive to industry peers who would see similar organisations implemented across the world. As such, the lauding of Zipline’s success as an example of lifesaving ‘innovation’ and ‘pioneering’ participates in the construction of a drone-based future vision, a narrative of the assimilation of drones into everyday lives and national infrastructure. Reinforcing the idea that the path of drone innovation for public health will inevitably bring health improvement supports a technological utopianistic vision of social progress. Further, the ‘lifesaving’ theme is supported by a tangential idea of drone usage which is ‘safe’ for various reasons. This appears for example as a ‘safe’ method for epidemic control, as authorities can enforce regulations and conduct surveillance from a distance, thus avoiding a risk of infection (Emery, 2016; DJI, 2020; Euch, 2020; Draganfly, 2020). It is also related to the manner in which

⁷ Ideas associated to technological utopianism drawn from Rushkoff (2002).

⁸ See for examples: Graboyes & Coglianesi, 2020; McCall, 2019; Hanna, 2018; Mesar, Lessig & King, 2018; Poljak & Sterbenc, 2020; Claesson et al, 2017; Elavarasan & Pugazhendhi, 2020.

blood samples are transported (WHO, 2019), to the language used to describe the objectives of pro-drone organisations such as UAViators and the Humanitarian UAV Network (Gilman & Easton, 2014, 9) and to the mechanisms, or ‘failsafes’ which are designed to avoid accidents in case of a technical malfunction, thus making flights ‘safer’ for civilians (George, 2017; Gilman & Easton, 2014, 9; Goodier, 2017; Laksham, 2019). The ‘safety’ of UAVs is also an important aspect of the military discourse, particularly in terms of safety for the pilot and high-tech militaries (Hijazi et al, 2019, 1286). The related ideas that the Drone *is* safe and lifesaving will not be investigated here, only what is *perceived* and publicly *argued*. However, it is notable that the promotion of such claims, whatever their validity, are likely to be made increasingly believable through sheer volume and make UAVs more attractive by consequence. The presentation of UAVs as ‘lifesavers’ improves the commercial image of drones and draws nuance to the conceptualisations of the Object, which would otherwise be predominantly perceived as a bringer of death and a military device (Tatsidou et al, 2019). Moreover, by directing the risk and reward perceptions attached to UASs, increasing the stakes for those considering adopting drone technologies. It can be seen as marketing rhetoric, as it frames the decision as a choice between trying to save lives or not, which makes a critical reflection on the potential monetary, legal, economic, and physical costs of greater drone assimilation.

4.2. Rise of the Revolutionary Drone

The UAVs is furthermore posited as ‘revolutionary’, ‘innovative’, and ‘pioneering’ technology. This concept appears across a range of primary sources, and seems to be a marketing tool, rather than an academic or engineering terminology.⁹ Like ‘lifesaving’, these themes also appear more implicitly, for example as a driver of greater technological revolutions (Berkley, 2016; Schwab, 2016; Bhatt, Pourmand & Sikka, 2018). Sandvik (2015, 74) discovered the similar repetition of drones as ‘game-changers’, changing how things are done, by whom, and what is possible in any given context. This discourse of ‘revolution’ and its related concepts fulfil a quarter of Gendron

⁹ See for example: Chan, 2016; WHO, 2016, 2019; DroneBlogger, 2020; Elavarasan & Pugazhendhi, 2020, 16; Tasevski, 2018; Haidari et al, 2016; Médecins Sans Frontières, 2014; Shaw, Kim & Hua, 2020; CartONG, 2014; DJI, 2020.

(1977)'s principles held by modern technological utopians, alongside sustained technological growth, which will eventually end economic scarcity, and ultimately put an end to all other major social ills. Further, another technological utopian principle is that technology will inevitably evolve and progress (Rushkoff, 2002). As presented by Interviewee A (Appendix 1, 90-91), the actual technological architecture of the drone is not entirely new and is much more the result of an improvement of its components, such as the onboard computers, cameras, sensors, and the battery. In fact, across the experts' interviews, the reduction of costs over time was believed to be central to the rise of drones in professional and civilian usage (Appendix 1, 88-89; Appendix 2, 108; Appendix 3, 122). Drones have been argued to be 'disruptive' technologies, meaning that this innovation significantly alters the operations of consumers and various stakeholders, replacing and causing major displacements in the existing systems and habits (Minges, 2019; Scott, 2020). Thus, the changes potentially brought about by UAVs may indeed be impressive in their disruption of the contemporary status quo in many domains and represent new opportunities for professional, personal, humanitarian, and indeed public health purposes, but the repeated assertion that they bring change supports a particular vision of the opportunities presented by drones; the highly affirmative statement that UAV technologies represent radical change for the behaviours of stakeholders on a global level illustrates the technological utopianism to which this vision subscribes. Further, the expert-interviews found that the descriptive 'revolutionary' was influenced by for-profit industry marketing, in similar ways to how other technologies, such as blockchain and AI, are regularly hyped in mainstream attention (Appendix 1, 92; Appendix 4, 136). This is thus fundamentally a marketing device which seeks to positively influence the image of drones, potentially increasing their public acceptance and legitimacy. The terms *pioneering* and *innovative*, synonymous to a degree with *revolutionary*, are much less assertive about the changes to be brought by UASs but remain optimistic and remain in the realm of positive technological progress. In this, they are also techno-optimistic. The repetition of such vocabulary lends to the association of the *idea* to the *Object* without critical inquiry. As there is rarely an explanation or argument in primary sources for exactly *why* a particular machine is innovative, pioneering, or revolutionary as compared to its peers or other technologies, it can be argued to be a rhetorical device to support a pro-drone perspective in simplified accessible terms. They communicate an idea of progress, moving onwards and upwards to better things through innovations in design and application of technology, a rhetorical tenet of technological utopianism.

4.3. The ‘rural’ and ‘outside’ space

Foley & Wiek (2013), in discussing the patterns of nanotechnology innovation, state that “cities have been the nexus of creativity, technical and non-technical innovation, as well as wealth generation for millennia” (pp.234). Drones, at least discursively, on the contrary operate for the benefit of the ‘rural’ and the ‘hard-of-access’ places. This theme is present in both primary and secondary materials.¹⁰ While intra- and inter-urban UAS networks are also proposed, the dominant narrative for HHDs and humanitarian drones as a whole focuses more on the rural and the ‘hard-of-access’, particularly in the discourse of NGOs and . Accordingly, operations are conducted as a means of connecting the centre to the peripheries through technology. By proxy, this theme alludes to the assimilation of the Outside into the technological nexus, the infrastructure of the centre. The need for this rapprochement is justified through the ‘life-saving’ properties of drones, whose ‘pioneering’ and ‘innovative’ capacities are allowing a ‘revolutionary’ ‘shaping of the future’. In fact, as previously suggested by Sandvik & Jumbert (2015) the descriptive language of the military drone often seeps into discussions of humanitarian UAVs, revolving around ideas of ‘precision’ and ‘surveillance’ for example. One could argue that it is due to the technology transfer of UASs from the military to the civilian domain that such vocabulary should cling to the Object, and the not-dissimilar performative functions that drones are suggested for. After all, drones were conceived for the purpose of facilitating unmanned remote surveillance, the ‘eye in the sky’ of high-tech militaries. This military-inspired language is also reflected in the linguistic choice of ‘combatting’ and ‘fighting’ viruses like Ebola and COVID-19.¹¹ The transferred technology is repurposed for humanitarian objectives by surveilling for the ‘enemy’ virus with precise information which will allow for greater efficiency in the ‘wars’ against threats to public health.

¹⁰ See for example; WHO, 2016, 2019; Chan, 2016 ; Médecins Sans Frontières, 2014; Skorup & Haaland, 2020: 1, 3; Boudway, 2020; George, 2017; Wright, 2015; Claesson et al, 2017: 124; McCall, 2019; Sandvik & Lohne, 2013; Emery, 2016; Sandvik & Jumbert, 2015: 143; Neate, 2020; WeRobotics, 2019, October 9th; Matternet, 2011; Poptech, 2012; Ledgard, 2014.

¹¹ See for example: DJI, DJI, [2020], 2020; Emery, 2016; Skorup & Haaland, 2020; Yaacoub et al, 2020, 11; Euchi, 2020; Elavarasan & Pugazhendhi, 2020; McNeil, 2018; Peckham & Sinha, 2017, 25, 26; Luege, 2014; Jakhar, 2020; DroneBlogger, 2020; Atherton, 2014; WeRobotics, 2020, April 9th.

Much like the ‘War on Terror’, this is a perpetual conflict to be waged on the hotspots concentrating socio-economic and cultural factors which create ideal environments for infectious diseases – this will be further developed later. Through this shared language, one perceives the threads connecting the different application domains. Regarding the connection of the centre-periphery through UAV technology, this implicit rhetoric can be seen at multiple levels, from the micro-regional with the city/urban to the countryside/village/rural, but also in terms of the global North-South. In the development of arguments for certain use-cases, the spaces perceived as ‘disconnected’ from Western techno-centric modernity are often targeted as the most suitable recipients of drone technologies because of the absence of existing infrastructure. Peckham & Sinha (2017) found that news media covered the use of Western technologies during the Ebola outbreak through an implicit framework of high-tech space technology pitted against the backwardness of traditional “primitive” burial rites blamed for increasing infection rates. The similarity in narratives between satellites and drones is interesting here, albeit not entirely unsurprising due to the common characteristics of the top-down visuals, data production, and Western techno-scientific origins. Elements of Matternet (2011)’s presentation video is particularly evocative of this discursive dichotomy; the posited commercial need is predicated on infrastructural underdevelopment – an absence of roads for a billion people – which is remedied by Matternet’s drone solutions, initially for delivering medicine and food before network upscaling and expansion. This techno-utopian marketing is supported by visuals, first through grayscale images of the ‘cut-off’, ‘dirt road’, and ‘inaccessible’ village, using visual representations of poverty and rurality to illustrate a ‘bleak future’, before transitioning to colourful images under the voiced-over ‘Matternet’ future of medicine on command for the mothers of sick babies. This drone utopianism envisions a quick-fix solution to systemic problems through the logistic-aid of UAVs. Further, it makes commitments, based on moral rhetoric, to connect “one seventh of our world population [which] is literally centuries behind” to the modernity of ease-of-access to basic goods and services. As such, drone utopianism promises to create access to the conveniences of Western modernity to rural populations, drawing inspiration from Eurocentric technophile understandings of progress and modernity, and moreover the rural is created in contrast to the urban centre and by the ‘military eye’ of the UAV, creating a chasm to be bridged or shortened through drone technologies.

4.4. The silent witnesses & cultural blindness

Within the analysed works, there is an oft silenced stakeholder of humanitarian drones; the people who would live under them. While appearing as onlooking crowds, thankful supporters, or testimonies, civilians often are seen but not heard.¹² Most of the emphasis of articles focus on events, perceived facts, industry members, political speakers, and indeed Drones themselves, but barely interrupt visions of the dronified-future to hear the voices of the public and communities. Risks are considered without referring to the those who may experience or feel threatened. Despite being the cost-bearers of drone technologies through the various possible misappropriations and malfunctions of the technology, the average person is underrepresented in these sources, a silent bystander in the roll-out of UAVs. Indeed, one could posit that since the English-language materials are intended for audiences outside of those communities, and thus do not feel the need to address their concerns directly and individually. Another important overlooked theme in drone-related productions is the social implications for communities, the potential economic reconfigurations, and the potential cultural impacts of their use. This is made evident when discussed in a couple news article; Burrows (2015) states that there are “cultural hurdles” in many parts of the world, such as those where drones are associated with “death and destruction”, while McNeil (2018) discusses the sensitivity of using drones in certain areas of the South Pacific where ‘cargo cults’ have survived since the Second World War. The general discourse thus speaks *to* and *for* the people, but not *with*, which can lend to a subjective or one-sided perspective of the drone debate and silence the voices of those who would potentially have to sacrifice certain rights and safeties for drone integration. This is not necessarily an intentional marginalisation but does result in the absence of input from a stakeholder to the benefit of a technocentric discourse. Although promoting human welfare, the discourse is focused on the technology and the excitement of new possibilities, rather than, for example, promoting localisation, understanding local wants and needs, and engaging with communities. Lastly, this relates in part to a concern for the place of communities in this process, whose absence in deployments of HHDs would be felt as distant, top-down, and unapproachable governance, and in specifically international applications as colonialist

¹² For examples, see: WHO, 2019; Wright, 2015; George, 2017; Matternet, 2011; Poptech, 2012.

legacy and Eurocentrism – this can indeed be integrated in current critical approaches to humanitarianism (Jayawickrama, 2018; Madianou, 2019; Assaad, 2019). Thus, this absence of equal partnerships, open dialogues, and community voices engenders one-sided and colonial perspectives.¹³

4.5. Risks

Another recurring theme in sources is the concept of risk; UAVs are understood as presenting new and unique challenges for authority, security, and regulation. While this may seem obvious, what is often overlooked is how these perceptions are constructed and find their way into the nebulae of meaning. As argued previously, the social factors which shape technology and its perceptions are also present in the assessment of risks surrounding drones. Comparing English and French language news coverage and academia, the threat of terrorist misappropriation appears much more immediately in French sources (Bauer, 2019; Chodorge, 2019). Being a nation with a recent past of domestic attacks on civilians and an active high national threat-level, French public consciousness is bound to be a social environment that is highly aware of new sources of potential danger. Threat perception is further informed by media coverage of drone misadventures, such as the drone flights in Gatwick (London) airport which grounded flights for days in 2019, and the several flights of a UAV over a nuclear power station in 2014, even seeing twenty in just one month (Bauer, 2019; Rapier, 2019; Theunissen, 2014; Appendix 2, 110). Moreover, as cases of drone-related injuries rise (Chung et al, 2017; Moskowitz et al, 2018; Johnson, Svach & Brown, 2019), the probability of higher-risk assessments and thus fear of drone accidents is likely to increase. As ideas are interconnected and embedded in systems of ‘functional interdependence’ the perception of risk as a collective system, amalgamating individual beliefs, influences the public acceptance of drones through patterns of interconnections among perceived risks (Zhu, Pasch & Bergstrom, 2020). In the civilian domain, public acceptance is a hurdle to overcome for pro-drone actor-groups before greater integration. Thus, perspectives and recurring risk themes which converge on certain risks are revelatory as to the tenets of a given risk-belief system in a social context, and conversely

¹³ Colonial as used in Couldry & Mejias, 2019.

can also be attempts to proactively shape the narrative to more manageable aspects and areas. If the goal is to sell a product, then public acceptance is needed to ensure regulatory freedoms. Thus it is easier to frame a discussion around seemingly less personal risks such as the obstacle of developed urban infrastructure, or bureaucratic roadblocks, rather than the potential use of drones for private espionage, identity- and gender-based violence such as stalking and honour killing (Woodlock, 2017 in Sandvik, 2019, 36), low-cost kamikaze vehicles, or tools for authoritarian governance (Shaw, 2013; 2016).

Moreover, risk-belief systems will influence perceptions of what is needed and what is desirable in terms of drone use-cases. Economic risk and public risk-acceptance influence what is seen as economically viable in the production of drones and is a determinant amongst others for profit-seeking companies in their decisions of where to establish business ventures. In this sense, it is more profitable for a humanitarian public health drone company like Zipline to establish themselves in an environment with less regulatory and individual risks by flying over open empty spaces, thereby improving conditions for profit.¹⁴ The risk-perception of such a company influences their design of a drone, its applications and capabilities, and the environment in which it ultimately chooses to operate. For Zipline, CEO Keller Rinaudo stated that he would have preferred to operate directly in the US but that that had not been possible because of legal conditions (George, 2017). The perceived risk of producing a product for a market which would not allow its effective retail directed Zipline towards a different more accepting regulatory environment. Securing an easy market entry is not only profitable in the short-term, but also in the long-term by creating an image, or vision, an example that can be sold on should the image be well-managed.

¹⁴ Conditions here derived from example of Zipline's operations in Rwanda, where efforts are made to avoid populated spaces (George, 2017).

4.6. Applications

UAVs are most often presented as tools for delivery, aerial photography, mapping, and surveillance use-cases, particularly in disaster management.¹⁵ The WHO (2016) made a case for vaccine and emergency medicine deliveries using drones, a vision supported by many. The anticipated benefits of medical applications of UASs are considered more pressing and legally feasible than commercial deliveries (at least in the US), as pioneered by companies such as Amazon and Google (Anderson, 2014; Weissbach & Tebbe, 2016, 38). These futuristic visions build perceptions of the cityscapes of the future. However, certain ventures are being built in opposition to this vision, as is the case of last-mile deliveries using electric bicycles, more ecological and efficient for intracity deliveries than trucks while also making use of existing technologies (Marchand, 2019). This is an example of how ‘rudimentary’ or non-high-tech technologies are being used adaptively to existing regulations and needs without needing major technological innovation. Health crises, such as pandemics, also generate new applications due to the induced fear and urgency, felt both by the decisionmakers, who are more vulnerable to short-term vision because of the pressure of expectations, and the public, who may become more accepting of drastic measures if it means a greater sense of protection (Nay, 2020; Chia & Oyeniran, 2020). Crisis situations are thus catalysts for change across all areas of society. COVID-19 has been such an example, as numerous countries have deployed drones for health objectives, such as payload delivery, area spraying, farming, and enforcement of social distancing measures (Sinha, 2020; DJI, 2020; Yang, 2020; Lane, 2020; Ruiz Estrada, 2020; Anggraeni et al, 2020; Rothschild, 2020; Angulara et al, 2020; Elavarasan & Pugazhendhi, 2020; Shaw, Kim & Hua, 2020; DroneBlogger, 2020; Lewis, 2020; WeRobotics, 2020, April 9th). The pandemic emergency has facilitated and sped up the process of drone integration in many countries and will likely shape perceptions of their utility and acceptance. The logic follows that if it is acceptable to use such technology in a crisis like COVID-19, then why

¹⁵ See for examples: Chan, 2016; Boudway, 2020; WHO, 2016; Berkley, 2016; Médecins Sans Frontières, 2014; McNeil, 2018; Vayu, 2016; Wing Medium, 2019; George, 2017; Anderson, 2014; Wright, 2015; Burrows, 2015; Inveneo, 2014; DroneBlogger, 2020; Boutin, 2018; WHO, 2016, 2019; Gilman & Easton, 2014; DJI, [2020], 2020; Luterbacher, 2018; Tasevski, 2018; Sandvik & Lohne, 2013; Lane, 2020; TED, 2017; Vayu, 2016; TIME, 2018; Matternet, 2011; Poptech, 2012d.

not apply it to other perceived crises – such an example is the opioid epidemic in the US, where drones have previously been suggested as a means of expediting medication faster than a conventional ambulance (Ornato et al, 2020). The ‘lifesaving’ and ‘safe’ discourse further encourages a rapid installation of UASs in situations of crises, as they support a vision of positive outcomes.

4.7. Epidemic Drones

Epidemics, as crisis situations, have attracted the attention of HHD manufacturers, as manifested by widespread reports of drones being used for various applications in relation to COVID-19.¹⁶ It is not the first time drones are presented as means to tackle pandemics; HIV/AIDS (UNICEF, 2016; McNeil, 2018; WHO, n.d.), Ebola (Goodier, 2017; Invenco, 2014; iHLS, 2014; SPI, 2014; Tucker, 2014; UN, 2014; Gregory, 2014; Atherton, 2014), Malaria (WHO, n.d.; DJI, [2020]; McNeil, 2018; DroneBlogger, 2020), and Zika and Dengue (WeRobotics, n.d., 2017 June 12th, 2018 April 19th, 2018 December 13th). The idea of the ‘pandemic drone’ has arisen from this wealth of applications, born from the perceived need for such technological countermeasures. Sandvik (2014, 2015) has extensively written about the drone utopianism underscoring Ebola drone applications, which constructs UAVs as capable of completing numerous tasks perfectly and ‘saving’ Africa through technological ‘progress’ and logistical connectivity (2015, 78), the result of a convergence of technology, the virus, and understandings of humanitarian governance (2014). Pandemic drones are thus the specific designs embedded in the context of different epidemiological crises, generating new perceptions, and reinforcing existing discourses surrounding the Drone artefact. These further reinforce the moral economy of the ‘good’ drone, gaining capital through the appearance of goodwill and humanitarian commitments.

¹⁶ See: DJI, 2019, 2020; Sinha, 2020; Lane, 2020; Jakhar, 2020; Rothschild, 2020; Peru Flying Labs, 2020; WeRobotics, 2020, March 25th; 2020, April 9th; Draganfly, 2020; Captain, 2020; Elite Consulting Inc, 2020; Neate, 2020; Burgess, 2020.

4.8. #DronesForGood: Drones on Twitter

Twitter is today an established social media platform which can be considered a global forum for discussion, debate, and sharing which provides an alternative to the traditional forms of information sharing of mass media and government sources. Hereafter follow some relevant narratives which are given space and voice in the global forum through Twitter. Through these narratives certain understandings and visions are reinforced, illuminated, and communicated to a potential audience of anyone with access to the internet, a growing demographic in an increasingly connected time. This analysis is in a new section as it is a different type of medium with different expectations for the relationships created between users and the responses to communication. It also gives a platform to anyone, which as a result gives pro-drone and anti-drone voices equal opportunity to voice their opinions and narratives, and allows for more implicit marketing and promotion of ideas, appearing less institutional than traditional media via the individual. It further encapsulates and perpetuates the different themes found in traditional media listed above. Dominated by the accounts of drone companies, trade groups, and training providers, the hashtag #DronesForGood brings together announcements, videos, news, articles, and pictures whose common theme is the promotion of ‘good’ or positive applications of drones. For example, a short twenty second video, reposted several times by different users, shows a drone delivery of a defibrillator, reportedly on a Portuguese beach (IEDO, 2020). It is tagged #DronesForGood and #DronesSaveLives. This related hashtag is similarly composed predominantly of users from companies, pro-drone associations, and industry members. Highlighting different hashtags is interesting as they are an easy means of organizing and categorizing information and creating a discussion around a topic. If popular enough, these can also ‘trend’, attracting more eyes and conversation to a subject and/or movement. The hashtag itself is a catchphrase which represents an issue conveniently and memorably, although due to the hundreds of issues being brought up across the internet, not all make it into mainstream attention. They do however engender and capture specific rhetorical narratives, which is why they are useful datasets for contemporary issues even if they do not attract major attention. Certain users such as @AIRTngo state in their bios that they are organisations with the objective of promoting #DronesForGood (AIRTngo, n.d.). Another account @WomenandDrones specifically seeks to promote stories about women in the UAV industry (WomenandDrones, n.d.). They promote events, like the FAA Symposium

(WomenandDrones, July 31st, 2020), and even children's activities revolving around drones (WomenandDrones, August 4th, 2020). The need for a promotion of a gendered approach to UAVs is linked to the notable absence of women in STEM areas, employed in drone operations firms, and even in the customer base due to gendered and socially constructed factors (Kuzma & Dobson, 2018). However, a simple Google search reveals many groups promoting the greater integration and celebration of women in the UAS industry specifically opposing this systemic exclusion. This site of conflict for recognition seemingly reveals the capacity of technology to both reassert a status quo through the enactment and replication of existing socio-cultural norms and relationships, while also providing a medium for opposition to the marginalized. Taking the example of gender, the STEM fields are particularly male dominated, possibly as a result of the attribution of technology to masculine role in Western societies as a historical legacy of female exclusion from technological knowledge (Williams & Edge, 1996, 879). This can also be seen today in societies, for example those with Islamist ideologies, where gender inequality is high and women are deprived from education or marginalized from specific forms of education and employment (Ispahani, 2016, 101). Thus, in any given social context, drone production would most likely participate in, reproduce, and reflect sexual divisions of labour and gender roles during the innovation, production, and marketing phases. Despite this, modern feminist research on the social shaping of technology has argued that the artefact can give the opportunity for the marginalised to become actors as the social intentions and factors which shape technology and its production can constrain the flexibility of a machine but cannot comprehensively assert a particular use or meaning (Williams & Edge, 1996, 879). As such, the HDD and the UAVs in general can be sites of liberation and conflict over gender issues through the repurposing and appropriation of use-cases, knowledge, and applications. This duality is fundamental to critically approaching innovation, team composition, field research, and implementation of projects. For example, the HDD, in its integration in different socio-cultural contexts, can be an active reproducer or challenger of sexual divisions of labour, by electing to reflect local standards or proactively balancing the knowledge transmission to diversified marginalised and excluded groups.



Photograph 1 - Promotional poster for the FAA UAS Symposium in August 2020. Found <https://twitter.com/FAADroneZone/status/1288874724236365824>.

Returning to Twitter, a promotional poster for the August 2020 FAA UAS Symposium shared by @WomenandDrones (WomenandDrones, July 30th 2020) encapsulates a range of ideas; quickly enumerated, an ICT-enabled quadcopter is pictured delivering medical supplies in a city setting, flying over cars and buildings. This visually depicts the narrative of drones for public health ‘last-kilometre’ payload deliveries, safely occupying spaces over vulnerable users and property. The subtly ambiguous caption can also be read in two ways, the first “Drones; Here for Good” implying that UAVs are progressively and inevitably being integrated, while the reading “Drones – Here for Good” states the purpose of the machine, playing to the discourse of humanitarian and socially positive consequences of drone usage. Images and videos also participate in reinforcing visions and narratives, as the symbolisms and meanings attached to them generally rely on participative understood interpretations. The symbolism and positive colour palette relay a techno-centred and techno-utopian vision of the future.

The user @CharisUAS (CharisUAS, n.d.) represents the company of the same name based in Rwanda. Sharing many articles, photographs, and videos as marketing materials for their services, the company participates in the aforementioned discursive practices found in traditional media. For example, their work with the Rwandan national police in the context of COVID-19 is framed as “#fightingcovid19” and “fighting the spread of covid-19” (CharisUAS, April 17th 2020, June 9th 2020, August 3rd 2020). Further, their work for curbing Malaria is also framed as a “fight” (CharisUAS, July 21st, 2020). Drones spray pesticides in wetlands to control potential malarial outbreaks, which is an example of the technological fix; mosquito-borne diseases (MBDs) are for the most part currently controlled through chemical methods, however Fernandes et al. (2018) argue that certain mosquito species are becoming resistant to pesticides, and that new technologies need to be evaluated against simple approaches such as bed nets and environmental modifications to be recommended for application in MBD-endemic countries. Indeed, pesticide-spraying drones are one example of a short-term high-tech solution to a problem which may necessitate simpler ‘appropriate technologies’, or long-term structural and infrastructural changes. As recent research has suggested, environmental changes and degradations such as rising sea levels, forest fires, and global warming, are connected to many emerging infectious diseases as drivers of infection (Peckham & Sinha, 2017). The environmental and socioecological sources and drivers of infection can be analysed from imagery in tele-epidemiology, environmental biosurveillance providing a system for detecting early warning signs (Peckham & Sinha, 2017). However, this methodology is compromised by the danger of predictive ‘hotspotting’ of danger which misses new sites of potential disease emergence, and is better integrated with horizontal data collection as well as vertical image production; thus while providing a means to an end, drones and drone productions must be combined with other concrete and purposive action. The anticipated “dronization” (Chamayou, 2013 in Peckham & Sinha, 2017) of global public health care must take involve critical investigation of the corporate claim that disease can be pinpointed from above, as the only the second-hand effects of an epidemic can be *read* as an active production of knowledge in visual imagery, and not in fact passively *seen*. Again, the parallel of satellite imagery, the images and data produced by drones invite the viewer to a parameterized leap of imagination, with socially predetermined points of interest. The data cannot become information without passing through this *reading* process and is thus contingent on being socially produced to be useful. This process is usually asymmetric, having been contracted by, paid for, collected for, and generated for specific

actor-groups without contact with the communities below, and asserts a specific form of technoscientific governance on a problem. Such techno-centred production of knowledge and governance also neglects any long-term social paths of progress, such as risk and hygiene education or aggressive environmental protection, which could dramatically reduce the underlying causes driving the creation and survival of infectious diseases.

4.10. Discussion

The hereto highlighted images, visions, themes, and language which surround the use of drones for health-related social objectives have showcased some of the ways in which drones are understood and discursively created through online spaces. Fundamentally, a contrast is created between the “good” and “bad” drone, moral associations drawing ethical capital from their associated use-cases and perceived results. As such, the artefact is framed as a tool whose morality is derived from its application and a narrow-parameter consequentialism, most often neglecting to address the social influences and impacts attached to the Drone. This rhetorical distancing from the UAV’s militaristic past is engrained in a desire to reimagine the Object and reformulate its public image, usually with the view of supporting increased integration and greater assimilation of this technology looking forwards. It is a particularly popular narrative for stakeholders with commercial interests, such as industry members. Arguably, this has spurred inappropriate uses of drones, where promises are not always supported by conclusive empiricism and experimentation, as exemplified by the numerous reports of drone usage during the COVID-19 outbreak in which UAVs have played unconvincing roles (WeRobotics, April 9th 2020). The idea of a ‘pandemic drone’ is embedded in drone and technological utopianism, seeking solutions to complex problems with technological resolutions which have not necessarily been demonstrated as improvements on existing, more rudimentary options. Moreover, UAVs, including HHDs, must be understood as socially embedded, diverse analytical lenses allowing for critical readings of societal and institutional relationships, influences, and impacts. As such, a constructivist approach to perceptions of Drones and their usage counters technological determinism and somnambulism, as for example the complex relationships between UAV technologies and gender, colonialism, inequality, and Eurocentrism are extrapolated from predominant understandings and discourses. In illustrating the sociality of the Drone, visions of the future can be measured against these critical

reflections, and efforts made for regulation and shaping. Being embedded in ‘drone utopianism’, certain applications of drones solicit a positive public response as a bridging measure to greater acceptance and a reduction of fear via the proxy of decreased perceived risk. The moral economy of ‘positive’ applications and the ‘good drone’ facilitate the creation of dronified visions, and support UAV assimilation. This utopianism is particularly supported by commercial and military interests for normalised drone usage.

V. 'To Drone or Not to Drone?': Implications for the Future

5.1. Using 'Visions' and 'Utopianism' for Forward Thinking

A case can be made for making use of 'visions' as a framework for critically evaluating narratives and discourses around subjects by understanding the impacts of the present on understandings of the future and the '*Not-Yet-Become*', and thus the motivations and perception-creation behind forms of utopianism. These understandings can be influenced by the proactiveness of agents within the actor-network but are also independent of it and cannot be made or broken by only one perspective. Using 'visions' as a means of understanding the actions of agents that are bridging their operations, exploiting current opportunities for the purpose of preparing the grounds for future innovations and projects – in essence, using the concrete to make the tangible become real. Such an understanding is useful for analysing existing discourses but also for the formation of guiding principles for a given society; as visions composed of images feed utopianism, fully understanding and proactively guiding visions towards undisputed values, accepted in a social environment with appropriate knowledge of what is being struggled for. This may help counter the restrictions of rights and freedoms of peoples in crisis and emergency situations which gradually seep into the norm, and more explicitly for drone usage, may help establish adequate regulatory and normative barriers to usage which may contribute to avoiding the worst of the potential risks this technology brings. For example, certain human rights are being encroached upon by public health surveillance (Chia & Oyeniran, 2020; Nay, 2020), and agreed-upon understandings of the future could help ensure a return of those rights post-COVID. Hence, a discussion of the social factors behind the drone may help guide post-COVID drone usage in the most practicable, meaningful, and ethical ways.

Understanding the ways in which drones are constructed also allows for an informed discussion for the ethical debates which involve UAVs, such as privacy. 'Visions' and 'utopianism' can thus serve three functions; the stimulation of divergent and visionary technological ideas and development, the generation of new sources for vision-building and assessment, and thirdly the development and extension of procedures by which to identify, modify, and select *leitbilds* and desirable futures (Dierkes, Hoffmann & Marz, 1996, 141). Knowledge cultures of the different

academic fields must participate in these debates to counter one-sided techno-fetishism and techno-utopianism through interventions in everyday decisions in the practical decision making and debating process.

5.2. Regulating drones

Speculating on the future of UAVs is not in the analytical interest of this piece, however some normative considerations can be voiced as to the nature of regulations; regulation can lead to socially desirable avenues of innovation, bearing down on controversial applications and adapting the technology to the context (Maclaine Pont, van Est & Deuten, 2016). Moreover, a sense of urgency for the need of strong and adapted regulation would greatly support policymaking, as the rapid and complex development of drone technology will surely antagonise the clarity of debate. At the juncture of new possibilities, UAVs certainly offer new opportunities, but these must be critically evaluated against a technological determinist understanding of innovation for innovation's sake and should be constricted to demonstrable and quantifiable added value. Negotiations need to be open to the public and conducted by specialists as well as social scientists for the purpose of openness and epistemological reflection. Most critically, the fundamental understanding of the flexibility of technological innovation needs to be conveyed so as to avoid 'technological somnambulism' into a future mediated by profit and military advantage, as these are likely to have disastrous consequences on global human welfare. Tatsidou et al (2019)'s recommendation for an internationally accepted framework, language, and code for humanitarian drone usage is a proactive and sensible solution for guiding and regulating the future of drones. Such a framework could be further sub-sectioned to specific use-case categories to guarantee precise language and understandings of the correct process for creating, acquiring, deploying, and decision-making for drones. Another element to consider integrating in this framework would be the relationship of drones to environmental phenomena, as they may perturb nature's status quo and disrupt the living conditions of fauna and flora, such as the flight and hunting behaviour of birds. The imperative is to temper a purely economic drive of drone innovation and application in the humanitarian field so that potential applications are considered thoroughly, critically, transparently, and ethically. As such, any guiding framework must imperatively involve academics from various disciplines and agents from both sides of the drone-debate. The Dutch government

is setting a strong example for proactive regulation of UAVs, engaging in a continuous assessment of risks, opportunities, and forms of use (Maclaine Pont, von Est & Deuten, 2016). For example, the emphasis and liability for security has been placed squarely with the drone user, proposed to be enforced through ID chips, which is expected to have consequences on use-cases and risk-taking. Further, the drone *Code of Conduct* (Humanitarian UAV Network, 2016) also sets an example for responsible and ethical drone usage and could serve as a basis for global regulatory efforts and standardisation. The importance of considering the future now is down to the disruptive status of drones; they present opportunities which stand to rearrange social environments, relations, and work conditions. As already demonstrated, the economic incentive is arguably the strongest factor motivating UAV innovation. As economic calculations for technological innovation are set in the future, anticipated up to a decade away in future costs and markets (MacKenzie & Wajcman, 1985, 18; Andersen et al, 2020), the regulatory environments created today will explicitly and implicitly shape the drones of the future. A study of the strategic responses of drone start-ups to regulatory constraints (Andersen et al, 2020) found that they are particularly vulnerable to these types of limitations, as they struggle to attain the legitimacy and resources to adopt conventional non-market strategies for influencing regulations to their benefit (pp.1). Moreover, the temporal orientation of start-ups - meaning the market-stage that they orient themselves towards - influences their reactions to regulatory constraints; those with 'bridging orientations' exploit current demands as a means of introducing future and visionary versions of their products (pp.2). Regulation must thus adequately strike a balance between directing the pace of innovation and implementation of HHDs to ensure safety and the reflection of necessity, while still allowing enough flexibility to support start-ups and innovators as they experiment and grow.

VI. Conclusion

At present, drones stand to disrupt the status quo in unforeseeable ways, as their ever-expanding applications each present new opportunities, advantages, and threats, each to be unique to the specific artefact, environment, and context. SWOT analyses such as Laksham (2019)'s article can seek to present summarized understandings of these, however this paper argues that these are socially contingent and inextricable from their origins, which consequently necessitates a critical reading of any propositions made within them. This is exemplified by the differences in 'inherent risk' perception according to the surveyed person or researcher, whose experiences with UAVs would condition their perceptions and expectations of future usage. As pointed out in one interview, (Appendix 1, 95), reactions to seeing one in the open would likely be dramatically opposed should the person be in a street in Sweden or in the middle of a conflict zone. This thesis has argued that humanitarian health drones, as a case study for humanitarian and non-military application drones, are politicised and socially shaped, and not merely tools and apolitical husks. It has countered a deterministic perspective which argues that technology evolves by itself with human intervention, thus being imbued with socially contingent characteristics and ideas. The Drone has also been shown to involve different stakeholders which each seek to influence the artefact, and ultimately participates in both the reshaping and perpetuation of socio-cultural systems. The discourse analysis subsequently presented further illustrates some of the ways in which predominantly pro-drone narratives are constructed online in publicly available resources, and sometimes repeated in academia. This builds a basis for future analysis of more specific case studies, whilst also allowing a critical view of the HHD as a result. Moreover, this socially embedded understanding is fundamental to organizing policymaking and regulation of technology, as these are formative in the innovation process and consequently may engender greater critically thought-out and appropriate regulatory environments for manufacturers. The analysis of discourse surrounding drones is thus a critical way of understanding the images and visions which surround the artefact of the Drone. Such an endeavour is useful for determining the drivers behind the rise of drones and the increase in considered systemic, professional, and humanitarian applications. A vision-based perspective of narratives bridges the present to the future in policymaking and normative change, as it incentivises critical reflection of changes and pathways to specific futures. It also induces caution as the 'statistical truth' produced by UAV data collection and the corporate

marketing inflating the standalone utility of drones across the multifold use-cases. The present findings support existing academic literature suggesting the existence of drone and technological utopianism, phenomena which are particularly. This understanding serves to put into perspective pro-drone narratives, cautioning against overly techno-optimistic understandings to approach greater drone integration cautiously. Being disruptive technologies (Minges, 2019), UAVs bring forth uncertainties and as-of-now unrealized opportunities, for which steps must be taken to affirm their benefits, and contain their dangers by first removing the mirage of determinism and novelty which could induce unwanted effects. Hence, accountability, transparency, ethicality, and critical thought are needed to ensure that innovation and optimism do not result in dependencies and the reinforcement of inequality.

The time, space, and contextual limitations of this study leave many gaps for future testing. Qualitative research on the assimilation and pervasiveness of various rhetorical devices surrounding UAVs in public consciousness would be empirically illuminating as to the nebula of ideas attached to the drone artefact.

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Appendices

7.1. Appendix 1: Postdoctoral Researcher; Engineer

Q: On your website, you have written about social drones and UAVs, so to start off with, what would be your title please?

A: My title would be that, um, I am a postdoctoral researcher at *Chalmers University*.

Ok. Let's start with the questions. In what ways does your organization, in this case yourself, interact with UAVs? In what locations? And please be specific as to the activities you research and study.

So what we are actively researching in terms of building prototypes, creating, uh, designs, artefacts, is UAVs for home environments and other, uh, sort of human populated environments like offices or streets, or could be a restaurant, could be a public space, so we're looking at close range human-drone interactions where a drone and a human are in the same room together, they're separated by meters, perhaps centimeters in some cases, and we are looking at those scenarios, uhmm, exploring various possibilities for those things. That is what we are actively building at the moment, but we might expand into other use cases in the future. We are also doing research, not in terms of building things, so not research through design, but we are also investigating other use cases including drone photography, drone racing, data capture and analysis, inspection scenarios, so we are exploring those topics by, uh, through our contacts with various experts in those domains and those inform our designs which are for the moment for close range drone interactions. So this is design research that we are doing. There are real world components to what we do, so we are investigating some use cases, some designs, which are intended to be or that might be deployed in the real world, but we are also looking at some speculative, more artistic, research approaches, looking at subjects which might be beyond the reach of current technology.

Would you have any specific localities in mind or is it just a broad theoretical approach?

So our project doing the actual constructive design research for drones has been only recently started, we only recently actually assembled the team. We are operating inside of a funded research

project where we are recruiting two PHD students and they will be handling the meat of the project, the hands-on, prototyping the actual research such as you are doing yourself at the moment, and since they have not even arrived yet it this is a very new project, just begun early this year only a few months ago, and it's a five year project, so that component has not fully started. However we do have some early results one of those results is a collaboration with a university in Australia, with MIT University with my friend and collaborator [redacted] for over there who has built a human drone interaction experience which is very much inspired by tai chi and it is actually called drone chi and this is a drone which is tracked by an optical motion capture system and the user's hands and this is the interaction between one drone and one human and the human's hands are also tracked very precisely this is like millimeter level accuracy 6 degrees of freedom spatial tracking and 3-D and there is a tai chi inspired movement and direction, kind of a meditative movement experience, between him and the drone so the drone flies around in the space and you follow it with your hands as it is flying round or you can also lead it. We are envisioning for example some applications for this for this particular design within healthcare, within perhaps diagnosing or treating or therapeutic applications or diagnostic applications for musculoskeletal disorders or certain neurological disorders that affect or manifest through movement, and so that was one particular prototype. Another project that we're working on right now, although it is the very early stages are drones for the home environment and this is where we would get more playful aspects so this could be a toy, or this could be a toy for your cat or your dog, so that's the kind of thing we are working on right now but I'm imagining that within this for five years timespan we are going to add to this and we can we will end up with a collection of maybe 5 to 10 use cases and prototypes for various locations.

These therapeutic applications, what kind of range do the UAVs have? Is it a few meters or further?

Oh so that particular application is at the moment controlled by a motion capture system which is a bunch of cameras set up in a space to track the movement of a drone and the human so you have multiple cameras in the same space and when you look at the same object through multiple cameras then you can triangulate you can calculate the 3-D location of that space so you need at least three cameras to do that, sort of like GPS where you talk to multiple satellites and they tell you your coordinates so it's the same kind of mathematical calculation going on but by tracking a little

markers in the 3-D space, uh, optically. So that is at the moment limited to the range, it's limited to the space where you placed those cameras, so it's usually a space that is a few meters by a few meters although it can be larger but it's on the level of meters not like kilometers, it's basically like in a room. And one particular development that we would like to conduct in our project is for example to explore other sensor systems perhaps integrating everything into the drone in which case we might gain the ability to move the drone between rooms or you know go out in a park and you are doing tai chi with your drone in the park it's able to track your movements and so on so those are the things that are under consideration and under development.

Okay great. So, you've just described how you would use these strong technologies in healthcare now could you see similar applications within humanitarianism?

Humanitarianism? How do you define humanitarianism?

I would define humanitarianism as projects which are for social welfare but within countries outside of one state control so for example it would be well for missions and programs under NGO control or without any sort of financial or political incentive, direct political or financial incentive.

So what I am aware of in that domain – I am imagining these missions involve people who might be at risk for some reason, so people who might be in a conflict zone for example that is what I'm imagining from your description and from those kinds of - for those kind of settings we are not directly working on these at the moment. But what I am aware of is that drones are being used heavily in search and rescue applications for example, where various sensors are equipped on the drone to detect - uh- for example if a building collapses then you send out a drone equipped with an infrared sensor which can pick up heat signatures of people who might be underneath the collapsed rubble. They are putting speakers on drones to announce certain things to attract the attention of people who might need rescuing for example. In humanitarianism - so those are the first applications that that come to my mind but there is also various surveillance sort of data collection applications that I am aware of where for example to collect information about what is going on in a particular space or a particular place so you send them out and without putting a person for example in danger then you can collect some information and take photographs or other sense of data regarding what is going on in a certain place. I'm not sure if that addresses your question properly...?

Well it addresses the Question definitely. Your description of the drawings which are controlled by the hand... spheres – Would something like this – could that be used outside of a building or is this something completely internal, something that is domestic in a way much like the sensory drone, the one with you move around with the sensors?

Yeah at the moment this is internal because it relies on something called outside-in tracking which is we have sensors which are In this case cameras But they could be other sorts of magnetic sensors and so you equip the space with external sensors which are connected to the computer and they track of the things that are going on inside of that space. To be able to do this kind of things for example with a drone to be able to track hands in the outside, in the open air, outdoors you would need something called inside-out tracking where all of the sensors are on the drones or on the robot or whatever it self and those look outside and they detect what is happening out there that would require one of two things either we develop – either we need new hardware basically because the problem with those cases is that you need the drones to be very small, if you have a large drone it becomes very uncomfortable to interact with at close range, so even a lot of commodity drones manufactured by, let's say the DJI, Parrot the drones that you can buy from a store where they sell drones they are usually quite large I don't know like maybe more than 15-20 cm between the rotors let's say, and even though this produces a lot of noise and airflow and the force produced by the rotors makes them dangerous to interact with close [inaudible]. If you put your finger inside a DJI rotor then you will get hurt, it will cut you. The drones that we [Inaudible] time we work with this company called Bitcraze And they are like 10 cm between the rotors I wish I had one here but I don't at the moment those are very small, they are very quiet compare to these other options they don't produce a lot of airflow around them, they do not hurt you if you grab one of the rotors, it's not going to be comfortable but it's not going to cut you so here's the problem to be able to detect hands or people you need to do computering on the drone and those drones cannot carry the circuit the computer that you need to be able to do hand detection or also a proper human detection does not fit on that drone you need a larger drone to carry that on the DJI... [connection disruption]. So these drones they do not hurt you even if you grab them they do not generate a lot of noise a lot of noise at close range and safe also. The problem is that you can't fit a lot on this drone, it can't carry a lot so the kind of computer that we would need to do hand tracking or person tracking, even like general point of interest tracking in video which DJI for example does quite well that requires a

larger computer and larger senses than our drone can carry. We need either for this hardware to shrink a lot which is a technological development that we are not directly working on but if it happens we will adopt or we need some innovative use of existing sensors, ultrasonic or infrared ranging sensors equipped on the drone, those might be used creatively to create the illusion of hand tracking, not exactly hand tracking but distance tracking around the drone so that might be a possibility. But another problem would be that these drones are very sensitive to for example wind compared to a larger drone so it is a trade-off situation there are engineering trade-offs associated with using smaller drones and a large drones and the smaller drones are more suitable for close range use cases but they can't do a lot compared to the larger ones.

Would you care to expand on what ways you can see you are UAV technologies involved in health-related social applications? So, you already describe the therapeutic uses, could you expand on that and describe some more.

To be clear I wouldn't say I described the therapeutic design, I'm more speculating on it because that is actually, whether or not they do have any therapeutic uses or diagnostic uses is a topic that we are investigating at the moment so we do not have a conclusive answer to that question yet. But we have - we have ongoing collaborations with, for example a hospital and certain physicians and certain experts in those areas where we are trying to answer those questions. But we do not have the answers yet, so it might be the case that you know it's irrelevant you know haha. So what other kinds of health related and so - so I might perhaps answer those separately because health related drone applications and social drone applications I guess might be different... in the health space I think there is some potential and this is why we are actively investigating this, this I believe there is some potential in these close range drone interactions where this could be a relevant for physical therapy for example or it could be relevant for, as I said neurological disorders that relate to movement... There... Thinking... I also know that in research there is a lot of exploration around how to use drones in the context of sports and exercise so people have built prototypes exploring what it is like to do boxing with a drone for example where you're trying to punch a drone that is flying in front of you. They did experiments around what it's like to be jogging or running with the drone they did [audio corrupted]. I am imagining that health related applications would more concentrate on bodily applications like movement related things rather than these

internal diseases. Except if, you know, if you get to things like pandemics where you might be trying to monitor a population which might, you know, against health risks and so on which might be the case in some places but this kind of application I would I would group it under... It sounds to me more like law-enforcement and policy enforcement really because that same kind of tactic, the same kind of application it more comes from law enforcement tactics or like crowd control or things like that so it doesn't directly contribute to changing the health situation, it doesn't directly address the health situation but this is for monitoring or enforcing certain kinds of regulation around the health situation. With regard to social applications which also kind of relates to health I guess one thing we are investigating also is use cases that might benefit people with disabilities so if I can't walk for example, I have trouble, I am bound to a wheelchair or I have certain other kinds of impairments for example, can I send out a drone in the world instead of going there myself to fulfil certain functions or... Can I send out the drone and have it scout out the area for example for me and by looking at the area, by shooting sort of pictures of the path where I am supposed to go to if I am in a new city for example, then can it find an optimal path for me to go with my wheelchair. I am aware of some research that... navigation and wayfinding for blind people, so blind people they can sometimes have dogs that they walk with, basically can you replace the dog with a drone is one question that they are looking at, and what is interesting is that in those studies what they found is that it does work and it actually works, better even, indoors so they can use it for object localisation, so if I can't see and I am looking for my keys around the room then there are certain interaction designs by which you know the drone can go find my keys and can be like 'hey they're here, come here' and I go there following the sound of the drone and so on so those are some applications that I am aware of.

Are those quite preliminary still are they quite theoretical or are they reaching the testing phase? Is it something that is being tested?

Yeah they are testing them... So here is how they test them. So in the final case if this were to become a product, let's say we are talking about navigation pathfinding for blind people, let's say this becomes a product, you open the box, you buy this thing from the store, you open the box, you set it out and it does the job and so on so in that case it would be an autonomous drone, you can't have a human pilot doing the thing because then there is no value in it because then you might as well just hire the human to help you with your day-to-day tasks rather than you go out

and buy the drone, so in order to become a product all of these cases almost have to be autonomously implemented. The technology to make them autonomous, at the moment, does not exist so what researchers do is that they imagine, they dream up these use cases and this is one way of how we work with future technology and future scenarios in our work, and they do something called 'Wizard of Oz experiments' so it's a technique in design research, in interaction design. I don't know if you are familiar with the story of Wizard of Oz but this is where the characters go to this place which is like a place that is run by a magical wizard that does magic and so on, but it turns out that it is just a man behind the curtain controlling certain machines or technological contraptions so it's not magic. So what we do is that we For example set up tests with human subjects where people come to try out this technology and the drone is operated by a pilot behind the scenes while the human participant who is experiencing the interaction and giving feedback and their opinions, or are you know performing the interaction while some data is collected, they might be under the impression that the drone is autonomous or maybe that they are, maybe they know that there is a pilot but they are asked to imagine and comment accordingly and so on. So, we build these prototypes which are human controlled in order to test the scenarios where that same design could be autonomous.

That was very interesting I wasn't aware of it. Okay let's keep going because I don't want to take up your whole day. Would you say UAVs are increasingly present in society?

On one hand yes, when you look at the market data that is the case when you look at certain industries like photography, cinematography, video making certainly you know like almost every photographer that I know of, every professional photographer that I know almost has a drone. Which was not the case a few years ago so in certain industries in use cases - certainly if an industry has a use case for a drone then it becomes very popular. They are very popular in construction, architecture, photography, in real estate for example which is again photography... Technical inspection scenarios where you have to go into a warehouse and do inspections with certain sensors or with photography to check for defects, leaks, maintenance needs and so on. Agriculture is an industry where they are very popular, so as soon as a valuable use case is there then they are very rapidly adopted. But for most of us for laypeople outside of these professional use cases they are not as quickly adopted and one reason for this is you know safety basically, any drone which is large enough to do anything useful will be... will bring some safety risks. Any drone that is large

enough to carry a good camera you can't go and grab it, you can't be too close to it. Like in your house it will generate a lot of air flow which will throw your papers and things around, it will disturb people near you and so on so, they are very very quickly adopted in professional use cases where people don't mind noise they just want to get the work done but their adoption in everyday life as let's say toys is less quick.

And what would you say are the factors behind this professional adoption? Why is it now that we are seeing more drones?

Well pretty much any professional use case scenario boils down to you now basically money, costs and profit, so if you... Cinematography, filmmaking, photography for example, what we learned is that - this is an actually active topic of investigation that we are doing ... Drone photographers, drone cinematographers other professional users of drones, I think racers also, hobbyists will also be topics in the future. So what we learn is that it basically boils down to cost. You know 10 years ago if you wanted to have an aerial shot if you wanted to take a video from a place from above you need to hire a helicopter which is more than \$1000 per hour, you need to have a crew of five going up in the helicopter doing various things, you know it's a very expensive operation. Today you call a drone pilot, send a drone up and you're done. So the cost of this operation has gone down drastically, more than tenfold, more than a hundredfold perhaps – cheaper to produce these videos. And the same goes for various other civilian applications where in agriculture for example you might want to spray your crops with a certain thing then instead of sending out a plane with a human on-board you can have the same job done by a drone actually autonomously once you set it up like once or twice you just don't even do anything you know you can program your drone to go and spray your fields or do whatever and come back and dock in its charging station and so on. So I am actually speculating here, I actually don't know if this is how it is done but I am sure that it is technically possible for many applications in agriculture, construction, inspection and so on for things to be done completely autonomously once you set it up. In many many use cases you don't even need a pilot you don't even need a sensor operator the drone basically learns from one example and then goes and performs the same inspection or the same operation over and over. They do however usually involve a pilot because things might go wrong and in that case you need to be able to ensure the safety of your equipment and also people who might be around so usually

there are professionals involved. But it boils down to it being able to do the same thing at 10 times or sometimes 100 times the cost.

So cost is the chief factor in all of this. Would awareness play any role in this as well?

I mean once you have a technology that's making 10 or 100 times a cost difference in your industry then people become aware of it pretty quickly [laughs]. You can't keep that secret for long.

That's a good point. Would you – what timescale would you say for this increasing integration of drones? Would it have been the last 2-3 years, 5, 10?

I think it's been, I've been told – and I haven't doublechecked – but it might be in the last five years or so and this is basically when like DJI I think got in the scene and started producing drones that do certain jobs very well. The engineering of the drones of these products has become very robust so DJI for example is a very large player in the drone market so I think they are maybe 80% of the drone market it's huge their market share in the civilian drone market and if you look at the history of DJI then you can see those milestones which correspond roughly to how the industry has evolved so now I am actually looking at the Wikipedia page on my screen and can see that they were founded in 2006 which was 14 years ago and they had the Phantom series – when did they, when did they released the first phantom so that's 2013 – I think the Phantom was a game changer in terms of its size and cost and abilities so that's when it's really started getting into professional industries like very widely adopted and in the Mavic got out in 2016 so these products are sorta like you know in the smartphone market there is before iPhone and after iPhone. In the market for civilian drones I think DJI's phantom which was seven years ago and Mavic which was four years ago 2016 I think those two were the defining products.

Well this time is very well with the next question which is – is the drone a revolutionary or turning point technology and please justify your answer.

[pause] I have a very high bar for revolutionary technologies. I don't think the drone itself I mean when you are talking about the drone it's a quad rotor aircraft and it flies around... That's been, the physics and the engineering of the quad copter aircraft has been known for many years. Before drones became popular we had helicopters, a helicopter is a drone basically, I mean it's human controlled but it's basically the same engineering calculation to fly a helicopter or to fly a drone or

any sort of propeller driven aircraft so the engineering is not new. What's changed in the last 10 years that put drones on the map or in use in a lot of civilian use cases, what drove the adoption was the miniaturization of integrated circuits so the computers that are on the drone they became smaller and smaller and smaller and smaller so all of a sudden you have a very small drone and this very small drone can first of all control its own flight properly like it's own flight algorithms which run to fly a drone at the level of smoothness or ease of operation that is possible on a DJI drone or a Parrot drone for example are sophisticated algorithms and they require reasonably powerful computers to happen. For example when we are flying our little 'Crazyflies' that I told you about the small 10 cm between rotor little drones that you can interact with in close range – those do you not actually do the same kind of calculations on board. They have some abilities for keeping themselves stable, but they are rudimentary compared to what is happening on a DJI. In fact, if you want sort of DJI level, like very proper precision then you have to do what we do which is outside in tracking with another position tracking system. So the computers which are doing this work on the drone have gone smaller and smaller, to the point that you can have a two or three kilogram drone carrying those computers. The sensors also, the photography sensors and other gadgets which are found on the drones. Battery technology is another thing – batteries have gotten smaller and smaller and more powerful and battery technologies is still being developed - solid-state batteries I think are on the map of these days – so what changed in the last 10 years in terms of what brought drones from being like a relatively unknown technology to widely adopted in certain industries is the improvement in computer hardware and batteries mostly, in my view as far as I can tell.

And would you say this is a viewpoint which is shared across the industry particularly in the way drones are marketed to the public and to states and NGOs? Do you see this – you know we might see the terms revolutionary crop up in marketing – now is this just marketing talk or is there actually some substance behind such vocabulary?

Yeah in my opinion when it comes to like – when it comes to marketing technology it's very often that people call things revolutionary when they are just building one more step on top of what's been technologically there, so technologically in terms of the engineering that's involved it's usually quite incremental but sometimes what happens is that you do these incremental innovations and sometimes you unlock something and by unlocking that one little thing all of a sudden your

technology is relevant to a whole new industry and boom you have ten million new customers and that is of course revolutionary but the path for achieving that revolution often goes through incremental innovations so... Marketing people love calling everything revolutionary you know, take AI for example - what people call AI- and AI has been the buzzword for the last 5 or 10 years again - maybe not ten but definitely five – what people call AI is just statistics really... It's a bunch of statistical algorithms... It's basically statistics, matrix algebra, calculus, combined and all of these building blocks the mathematics of this have been on for many many many years. I don't want to speculate but many years – and what has happened in recent years is that computers became cost-effective enough to enable programming and executing those algorithms at reasonable cost. So that was the driving force behind AI but if you ask the marketing people 'wow yesterday we didn't have AI and today we have AI and computers can do all of these things' - so there are two sides to it in terms of marketing yes it might be revolutionary because it does open up new markets like I said you do these little things - you know we're climbing the step, you're climbing steps and steps, and so every step is the same but you take one step and you're on the next floor and then you can access the whole floor, so in terms of marketing it might be revolutionary because it literally opens up a whole new market sometimes. But in terms of technology, the progression of technology is usually, usually quite incremental. Science and technology often that's how they happen usually it's very rare that something really really breakthrough is invented out of the blue.

I like your metaphor of the taking steps to reach a new floor. Who benefits from UAV technologies in humanitarianism? So to illustrate what I mean a little more, Brynjolfsson argues that in technology the first and most prominent seller, or what he calls technology superstars, get the lion share of the market and it seems that you have just described this inadvertently with DJI. What relevance to you see with this statement to UAVs into this kind of technology?

Do you mean in terms of humanitarianism in particular or more generally?

Well more specifically humanitarianism, I'm thinking which actors involved in the whole process benefit from the technologies but if you care to share some thoughts in general those are welcome as well.

Yeah I can start with the general because when it comes to humanitarianism in the sense that you described it, I am not super knowledgeable... I'm not the expert on that topic. When it comes to more generally when it comes to how technologies adopted there are various... Models of how people explain that. So one of my favourite models – and this is like if you go to business school they make you study this for sure or like you study innovation management – there is the idea of a chasm... So first of all there is the idea of a diffusion of innovations model, it's the case that technologies are adopted by various segments of the population at different stages. So first of all we have innovators adopting a technology: these are people who are technically very curious and so on and so forth. And then you have another - early adopters who are also super curious but perhaps not very talented engineers and so on but more like hobbyists and so on and then you have a majority adoption after those innovators and early adopters you get to an early majority and the late majority and so on and that's how the market involves that's how technology propagates in the world in societies. And the idea is that between the early adopters and the majority – so let's say this is between me and my mum, adopting let's say iPhones. So if you consider that I am an early adopter being involved in technology and so on and my mum is part of the majority who get it later, this is very oversimplified but – the idea which is due to a book by Jeffrey Moore which is called “Crossing the chasm” is that there is a chasm that needs to be crossed. There are certain needs of the majority population which need to be served before that chasm crossing can happen. There is certain definitions certain understandings around technology and how it is defined how it is marketed how we talk about it that need to be established before the chasm can be crossed. And if you look at the timeline of how technologies are adopted then you see that usually when something is invented and something becomes talked about developed, it goes pretty fast between innovators and early adopters and then there is a point in time when adoption sort of stops and it takes more than just technology development it takes the development of public consciousness it takes the... It takes the design of useful products enjoyable products for a majority adoption. When I look at drones I think drones as a technology have recently crossed this chasm into adoption because they are very widely adopted in professional use case it's like I said – every photographer that I know almost has a drone uses a drone... Construction industries, certain industrial large facilities which might need to be inspected all of them have drones. My university in Istanbul, when they organise large event, these are thousands of people coming into the campus I think you like festival graduation something like that on campus that they use drones to monitor and direct

traffic and for security monitoring they have a team of pilots who are employed by the University doing these things so I think drones – it is pretty certain that they have recently begun crossing that chasm and who does it serve I think was your question.

It was who does it benefit rather than serve because it would seem logical that it could be the person who is being helped through humanitarianism but maybe you have thoughts which are... Support this or contradict this.

So in humanitarian application as you define and that is not my expertise because that is sort of like the border between civilian applications and perhaps even military applications. I mean you don't you engage in conflict when you're on a humanitarian mission but some of the considerations I am imagining all the same so you're looking at search and rescue applications. And who benefits I think... I think the... I'm imagining that the work of the entities who might be undertaking those humanitarian operations might similarly to these other industries where drones are adopted – I think in terms of time and money that it takes to conduct certain operations, they might stand to benefit greatly by using drones I'm imagining. But I'm also imagining that if some... Let's say data intelligence gathering operation or search and rescue kinds of things if those require a human presence in an environment, then the operatives, the personnel who would be going out on the front line might also benefit because now they're not going out on the front line or now they're not putting themselves in potentially dangerous situations rather they are sending a drone. I am also imagining that it might be able to reach a further sort of distance or perimeter of... sort of expand the scale of operations, so in both sides, both people who are doing the operation and receiving the humanitarian aid who are the subject of the operation, I think both of the sides stand to benefit from the technology.

Okay well here I would like to extend this slightly – so you brought up military drones and this is actually quite important in my research as you said humanitarianism kind of straddles the line and often works in the same field as military drones. So what I'd like to ask you is we already know how military UAVs have become infamous for their roles in for example the 'war on terror' as it is commonly known, and state surveillance. And the UN has warned in one of its publications, it warned that humanitarian drones needed to be clearly demarcated for example through bright colours to show that they were not military drones, they had to try to disassociate them from military drones. Now do you... Do UAV

manufacturers need to distance themselves from the negative images and perceptions of military UAVs and if yes how would they do so.

So... I mean... I mean that's a problem of who is receiving, who is the audience, or who is – so imagine the point of view of the person who sees something in the sky and how they feel, so this is a this is a question of their perception and their experience. So, for example, most military drones and most civilian drones look quite different. A military drone which flies of a high speed high distances possibly carrying weapons and so on – if you look at the pictures of these things even you go online and compare DJI drone to a military weaponised drone they look nowhere the same. If you look and see one of those in the sky you can see which one is which one. There are however... However, as I said you also have to consider the point of view of the person who is looking at this and experiencing this. So, I live in Sweden in Gothenburg, when I'm walking on the street if I hear a drone if I look up in the sky and I see a drone I think it's a photographer you know taking pictures, maybe maybe it's the city itself doing some sort of maintenance inspection operation or whatever. I don't even consider the possibility that this thing might be equipped with a weapon or a bomb – this doesn't even occur to me “oh this is a photographer how nice“ but if you consider the point of view of someone who lives in a conflict zone if you think about someone who lives in let's say see you in a city which has been bombed in a city where drone military drone operations lethal operations have been conducted when they look at the drone it doesn't matter which drone it is, it could be a DJI photography it could be one of my little ‘Crazyfly’ drones when they see a drone they think “oh shit it's a weapon, it's going to explode it's going to shoot me down”, that's what they think so... So it depends on who is experiencing it and it is possible to weaponise all sorts of drones and it is also possible for malicious actors or violent actors if you want to hurt someone if you want to put a bomb on something... It is also possible that they will... They are gonna go paint their drone in the colour of the humanitarian drone and I am going to go look at the drone and think “oh it's here to save me“ but then it drops a bomb so when it comes to violence when it comes to violence, destruction, the creativity the ingenuity of people is boundless. You... But of course you can say the war crimes and rules of combat the code of conduct on the battlefield and then combat situations so it can be... There might be some value in using various signs, markers, maybe emitting certain sounds or using certain colours there might be some value in that in order to distinguish humanitarian drones or civilian drones from military drones in a conflict space. In the spaces where I live as I said it is not relevant because we don't have military

drones flying around Gothenburg in Sweden. But if you consider the other side it is very easy to fake those signs those markings. Now should the drone industry distance itself from the military – I think they already are. Companies that manufacture civilian drones they manufacture civilian drones and also some professional drones that are large and so on. If you go to the website of Parrot or DJI there is no other button section, calling, saying here is our military section, like that doesn't exist these companies already at least when you look at the marketing materials they are already quite distanced from the military. If you go to a company website which makes military drones that is very obvious that they are in the business of military drones and not photography for example. So they are already doing that on some level and I think all companies do that. Almost all companies that serve military purposes do some level of branding to distinguish the military offerings from their civilian offerings. I don't know if that actually answers your question or if you have any particular examples in mind that you would like me to comment on.

I was just thinking particularly for example of as you said this distancing of the civil facing and the military facing efforts or sides of a company. I was also thinking, the next question would've been – does lobbying exist within the UAV industry and what forms does it take and who is particularly targeted? Is it the states at a governmental level, is it the individual company or NGO level, how are you aware of this process going on?

I am actually... In the industries where I am in contact with, I am not aware of lobbying I am actually... I have heard... That the opposite is the problem, there is a lack of lobbying where regulations around how drones could be handled by civilian drones basically for example for photography or other purposes – in many places and many countries people that I've spoken to have complained about for example the rules changing all the time or these rules and regulations being made up by people who don't necessarily understand or appreciate the technology to the full extent. So photographers for example, drone pilots, I have heard complaints from these people around this but it is interesting that the complaints usually come from amateurs who fly smaller lighter drones which are subject to less regulations even though there is some regulation and they complain that it is too hard to follow the regulations, it is too hard to keep up with like sometimes licensing requirements, sometimes where you can fly and where you can't fly. When you talk to professionals who have heavier drones, imagine like big cinema cameras mounted on a drone, which are subject to even more regulation, they are actually - they are more content because they

consider their work to be aviation, they are flying aircraft they are not... So they don't distinguish between – I mean they do distinguish but they do understand or they argue that a drone, a helicopter, a propeller plane and a Boeing passenger plane all of these things they occupy the same airspace and they should be subject to similar or interacting rules and regulations, so they consider what they are doing is aircraft piloting and as you might imagine when it comes to passenger flight when it comes to cargo flights, civilian aviation, as well as military aviation there are tons of rules and regulations and practices that people have to follow and they... Professional drone pilots usually argue that their practice, drone piloting, should be subject to similar level of strictness. But amateurs argue that there is too much regulation and it is changing all the time. But I am not aware of any civilian drone... Any lobbying that's taking place in the civilian drones domain, at least not to the extent that it is in the military drones. So what you have to understand about drones is that the technology is a commodity. To understand how to design a drone to build a job it is actually very easy today to understand the basic engineering of it. You can easily create a company, hire some competent engineers, start building drones - like you would not, there are thousands of engineers who have that ability, who are able to execute that. There are many many factories that can produce the parts and components that you need to put together a drone. You really don't need super super super specialised people for most of the things, for like 90% of the work involved in building a drone, like some companies obviously have done a lot of effort like DJI has done a lot of work developing end-user applications, their offerings are incredible, the user experience is top-notch. Obviously that is something to be commended, I'm not saying that anyone could go out and do that within a day but to have a company that builds drones for the military is not - it's not the highest super specialised engineering – there's not like five engineers who know how to do it and that's it, there's thousands of engineers who could do it, so you know it boils down to lobbying when it comes to who is going to get the contract, who is going to get paid by the government or by a certain NGO to - to supply this equipment. There is competition in that space. So, lobbying of course I am imagining would be relevant but that's because the engineering is commodified it's a commodity – it's widely known these engineering motions around how to build design and construct a drone.

So you see lobbying happening the other way where – or rather you see that lobbying happening in the actual competition for contracts. The idea exists already at the state level

or certain NGOs to use drones and then the competition is for the contract not even for the initial stage of “let’s use a drone for this task” or you know - have you considered this.

I am imagining it would be so, I’m not deeply involved in that industry but I understand the engineering behind how drones are made and built and I understand some of the economics behind how such contracts are handled. I mean to, to build a drone you can have – there are thousands of engineers in the world and you can pick 10 of them and have a drone company and start building drones. That is the easy part. When it comes to selling – let’s say a 10 million contract to the let’s say Swedish military or the Turkish military or any states you know, to the states let’s say. There are a smaller number of people who can do that so the number of people who can sit in a room with a general or whatever and convince this person to spend a certain amount, a certain large amount of money on a certain acquisition or technical project – those people, they are very few of them compare to the engineers who can build drones. That that takes a specific kind of person, that takes contacts, that take salesmanship, that is very rare. I don’t know if you can call that lobbying, because lobbying as far as I can understand is when you’re trying to influence the laws in your favour, when you’re trying to influence regulation in your favour and sure there might be some of that involved and that’s of course involved in any significantly large government procurement situation. There might be, it might be the case that certain laws and regulations are... Under consideration for alterations to serve a specific interest. So that is what I know on a very general and somewhat speculative level. I don’t have any firsthand experience on that topic.

Let’s move on to the last question then I’ll ask you today. That would be – how would a legitimization of civilian, social, humanitarian, you know, retail applications of drones, affect state use in military and security fields. Is there a relationship that? Are there synergies in mutual learning effects? And does this have an impact towards the objectives and nature of civil UAV research and development? It’s quite a big question I understand.

Interesting question. Yeah... The short answer is I don’t know. The slightly... A related thought, even though I don’t really have the knowledge about this particular question – I do think that when it comes to... Like because I said there is a scarcity of people who can arrange such deals, this making this kind of deal with a state is a huge deal. So... They - when such deals are made, they are not always, always objective or very influenced by all the information, all of the practices going on out there in the civilian world so for example – it is possible in the military maybe they need

drones for particular surveillance application and maybe they have, and maybe if they just go out in a store and buy some DJI maybe that would serve their purpose but instead what they have to do is they have to get in a room with a specific person who has specific clearances and specific qualifications and they have to work with a company that has specific qualifications and clearances. They have to ensure that the components that go in their drones meet certain standards so for example if the Swedish military for example are maybe averse to drones which are made in China because you don't know what's going on in the factory you don't know what's going on in the chips themselves it's very easy to modify an integrated circuit, a chip, an electronic component inside the drone in a manner which is completely indistinguishable from the outside and all of a sudden you have all of your data being relayed to another state and obviously in military operations you don't want that. So of course there is a learning - technology is being shared in the whole world in various ways of course there is learning between the military and civilian applications, of course these practices and ways of doing things that influence each other but there are other considerations when it comes to state use of this equipment which in some cases slows down the adoption of certain things that are developed in the civilian space, in some other cases it puts them ahead. In terms of robustness of the remote control system for example to outside attackers, manual attacks whatever I imagine sort of military grade equipment or some other equipment that the state uses for mission critical purposes and certain rescue operations and so on, it might be more robust. But there are different considerations— When you are marketing a product to civilians when you are putting things in a store, when anyone can go into a store and buy things, it's a whole different economic business situation and when you are selling a multiple million dollar contract to state or military it's again a whole different situation. For NGOs it changes – it depends on who is behind it who is financing the whole operation what are they exactly doing so maybe one NGO for one operation they don't have a lot of money they just go out and buy the cheapest drones that they have at the store and they hack on them and so on maybe another NGO is run by George Soros and they have money you know [laughs]. So I don't know exactly the answer to your question but here are some thoughts.

Just the legitimation part of the question - what I'm thinking is, if so we have more and more of the civilian uses for drones we get used to them being in everyday life if your research is successful we might see them more regularly in hospitals, in peoples' homes – would this

legitimate, so make the public sphere, more open to the military and security aspects of drone technology which are currently somewhat looked down upon, or trigger some fears and concerns. Do you see any aspects of drone technologies which are off-limits or is it fair game as long as we can develop it?

That's an interesting question... Just to clarify about my research we are investigating certain applications in the home or in the hospital or whatever, and the conclusion of our investigation might very well be that no they shouldn't be deployed in this application so that would also be a success. We are just looking for an answer we are not arguing for – we are not trying to put them in there but we are investigating if it is valuable to do so. Are there anything off-limits? Do you mean in terms of developing...? Are there any engineering directions or technological directions that we should not be working on is that what you're asking for example?

Yes that is a good way of putting it for example.

... Yeah? ... I am not sure. If you look at base simple examples -atomic energy. It's the same, very similar physics to engineering that goes into building a nuclear bomb and a nuclear power plant. And also, nuclear medicine where they have, where they use radiation for therapy or where they use the same ideas in the physics and engineering to do imaging for example on patients. So, on one side you are destroying cities and on the other side you are powering in cities and saving lives. So, technology is usually quite... some people say it's neutral, some people say... The various view points on that and the obvious sort of first-order response to "ok if technology neutral then okay let's keep developing them but how do you keep them in control" – the first order response to that is regulation, it's laws and... Those can be ignored by some people you know I am imagining that there might be certain I guess malicious organisations, terrorists and whatnot that do not really care about regulations and even though you should not weaponize certain kinds of drones and so on they go ahead and do that and it's done but... I wouldn't say that there are any particular things that we should not develop, that we should not work on. What happens in science and technology is that sometimes actually you're working on one thing and while you are working on that you discover this other thing which is a super valuable right so if you – it is not linear you don't always set a goal and do the work and go there and achieve your goal. Science and technology doesn't always work like that so if you try to deliberately block the progress of science and technology in one particular direction then then it's a complex system that you're blocking off your blocking of

several other directions... Various other kinds of work through doing that. So the idea is that you could block applications, setting use cases through regulation but ultimately some people might circumvent those, then it becomes an arms race where you have to develop technology to stop the other thing, you know you develop missiles but then you develop anti-missile systems, you have fighter planes bomber planes aircraft we also have anti-aircraft guns and then on the plane they have this other system for countering that and then they develop this other system so it's sort of a technological arms race between different concerns and I think that's sort of what – that's the equilibrium situation that's in some ways it's unavoidable so that's what's going to be – I think deliberately blocking off certain engineering or scientific developments is not really a strategy that works in the long run. What works is you address the root causes so if you study economics or some related fields so if you are concerned about the particular malicious actions then you have to ask why is that taking place why is someone is dropping a bomb onto a drone and sending it in my face, why are they doing that, why do they hate me, and just make sure that they don't hate you you know that's the optimal solution that's the solution that works.

Sure but what about, for example to carry on the thought, what about the states use of surveillance and surveillance drones the so for example during Covid this has been quite useful for enforcing regulations and social distancing and it's been used to measure temperatures at a distance to see if anyone can be found that has symptoms that has not been to declared and could be infecting people walking around but the same technology could be used during protests to identify protesters as was done in France last year I believe through cameras which identified facial features. You could have similarly such surveillance just in everyday life, in England we have a lot of cameras in every street but this could be replaced through drones so that's what I mean by a legitimization, there is obviously good and bad or bad – morally, ethically speaking - applications for drones and it will be up to the individual to decide what a certain thing is, where it falls on the spectrum, but is there inherently any legitimization on the drones' part by creating more drones by making them more integrated into everyday life. Does that make them more likely to be used in let's say these unethical or immoral cases?

So you mention the case of surveillance I think – I'm not concerned about the use of drones in surveillance because drones – doing surveillance with a drone is for various reasons most often a

terrible idea. Because it's very noisy – if you want to do surveillance you don't want to be seen you don't want to know that the people you are surveying are being surveilled so if you fly a drone over a crowd everyone is going to see your drone, some people are going to throw rocks at your drone they're going to shoot it down you don't want that. I mean you could just – especially if it's the state that is doing that it's way more effective to just put cameras everywhere you can hide cameras you can reinforce them you can – it is hidden it is online all the time you don't have to take it back every 10 minutes to get charged it's like it's already there. We are always under surveillance by cameras, sometimes by the state sometimes if it's private property then by the owners or managers of that property, so drones are way less effective than just plain old fixed cameras for surveillance. I am not at all concerned about drone technologies and how it might enable surveillance applications because there is all kinds of surveillance capabilities that states and other actors have on us which do not require drones at all. So I think the commercial use cases opened up by the development of autonomous drones or drone technology is in general equipped with various sensors - doing the same technology that enables surveillance on humans – if you look at what the technology is enabling okay it does enable surveillance but it does also enable all these other applications in industries, agricultural construction photography all of that – those are huge they really bring measurable benefits to those industries and really enable those people those professionals to do new things that they were not able to do before they adopted drone technologies. When you look at what drones are enabling in terms of surveillance it's not really very much, they don't bring a lot of value on top of having cameras on the streets. They don't bring a lot of value in terms of finding, identifying people in crowds and so on you can already do that with a plain old camera. If you send out a drone instead you will risk it getting shot down and so on so I am - I am not concerned I think the development of drone technology in the adoption of drones across various industries and various civilian applications is the benefit that is being created by far far outweighs the risks of this technology being adopted for malicious purposes as far as surveillance is concerned because they are already much better surveillance capabilities that you can do with drones. Just go on social media, you can go track someone's Internet traffic, so you know there's all kinds of government records available on everyone, there's cameras everywhere, you don't need drones to surveil crowds.

Thank you for taking the time to do this you've been more than helpful this is really helping change my mind on some things as well.

7.2. Appendix 2: Project Manager for Drone Software Company

In what ways does your organisation interact with UAV technologies? What kind of organisation are you? What locations do you operate in? Please be specific as to the kinds of activities and your involvement in them.

Alright. [redacted] is part of the Parrot group, which you may know that Parrot basically developed and has been pioneering in developing drones, first for – I mean mainly for the civilian market, but for, er, consumer markets, but more recently, in the last 5, 6 years, for professional applications and businesses. So Parrot group also owns [redacted], which is a sister company of ours. [redacted] has basically grew with drones and UAV since the beginning through the photogrammetry software which we provide and we develop. So the main applications in the views from drones and aerial and digital sensors. That is really the mainstream currently, in terms of photogrammetry and pictures, whether it is quadcopters, typically the Parrot Anafi or the DJI, basically drones, or the fixed wings. So that is typical applications. The company is based in Lausanne [Switzerland], the main headquarters and a big part of their R&D is based in Lausanne, has been historically, came out of the EPFL which is a university in Lausanne, and has offices in Madrid, Denver, San Francisco, Taiwan, hmm I'm missing some, Berlin and also in China, Shanghai. So some of those offices, typically US and China – and Madrid – are sales office, representation office, subsidiaries in fact, and Berlin and Madrid also have some product development, Madrid more towards inspection software applications, and Berlin towards emergency response including humanitarian in terms of the fields and applications of the software.

In terms of the structure, you say you have a parent company. Is this generally speaking, a financial and practical decision or do they also direct the research and the kinds of actions that [redacted] conducts?

To my knowledge they do not direct and they really leave companies to make their own business decisions, obviously they oversee the overall group strategy, and the financial sustainability of

the companies, including investment, but the – each company, I am speaking at least for [redacted], has a freedom in the strategy which they will want to implement.

So, what is your understanding of the involvement of UAV technologies in humanitarianism, and where are they most valuable?

Absolutely, so this is a growing sector obviously, it has, hmm, it has grown primarily, I mean it has been attempts to fly drones, typically in Haiti, in the Haiti earthquakes, I believe in 2011, when a big part of Haiti was flattened because of the earthquake, so typically the United Nations and other organisations flew for one of the first times to be able to assess the damage and map for to be able to see the impact on the communities and the response to be given, so typically, IOM which is a International Office for Migration was one of the pioneers in flying and testing, it was very much of a makeshift solutions, not as tested and as robust as it was, and then there is organisations, like WeRobotics, that I mentioned as well, which we really took that at heart to pioneer and develop a code of conduct and also measures and ways that drones in humanitarian contexts can be applied in respectful ways, as well towards populations and communities. All companies develop software, typically, these software can be developed for various professional usage including humanitarian emergency response, first response, public safety contexts as well, and from the early onset of the applications of the software, they were used by the United Nations and other NGO sector to be able to see it. So the humanitarian have been quite an early adopter but the growth has not been as fast as other professional sectors like construction, surveillers and all, I would say mostly because of a challenge of funding, the umm, reticence of humanitarians to invest in innovation, which is a big part, because there is little funding for innovation because they really need to show that every dollar spent is being invested into the field ideally and also the risk element. When you deploy in a humanitarian context you want to make sure that all the solutions you deploy are proven safe and effective. At the time and even now, many are doubting or questioning, or are simply inexperienced about how to apply the solutions in the context. Or simply, and that is changing, and that is why some organisations like WeRobotics is employed, is changing the perspective to train local capacity instead of having European, North American whatever coming in, coming with full with full gear equipment and flying contexts they are not aware about.

A little more specifically, in terms of a focus of my research, I am looking at health related applications for drones. In what ways could you see UAV technologies being used in health-related social applications? Public health?

So typically, um, there is a number of applications that – where drone UAV could be extremely useful. One is a classic one, again organisations are doing it, it's about disease prevention, typically malaria, so I believe WeRobotics but also others are doing seeding, so mosquito seeding, to prevent Malaria. There is also a humanitarian context because of the access or lack of access can enable the delivery of blood samples to remote access which would otherwise be too expensive or too long to reach, and other type of health. Now, public health is also about mapping area that could be endemic to difficult situations. SPRITZ, the machine learning yet is not fully or enough developed or applied to understand the – to do in terms of predictive analysis and context analysis but it's coming, it's coming there so basically it's not just about responding it's also about preventing, and this is something where a UAV could really play an important role in the providing access to primary health care/

So you mentioned Malaria – are there other applications outside of, well we see drone technologies being quite – being used quite a lot for COVID in France, in China – aside from COVID, what kind of epidemic or public health concerns can drones be involved in?

I think that any diseases that bring, or epidemics, that may lead to population movement, may... drones, basically it's about mapping, always the challenge it's about keeping people's anonymity because drones' camera lenses can be extremely now strong and powerful, potentially near military grade as well so there is the security concern, but in terms of specific disease application, I could not respond, someone specialised on the field would be more specific, but I will say about mapping population movement when there is this kind of disease because people move [cut off, doubt about connection being still there]. This type of mapping all, in terms of, health, semi-health related, is about water access, in terms of water pollution, typically a lot of applications are being used for agriculture, so if the same intent towards agriculture was being

put towards food security and nutrition, this could also be very effective for populations to see, or specialists to see, crops growth and access to healthy and safe food for communities.

I'm going to jump ahead in terms of my line of questions because you actually started to touch on something which I was going to ask you about later, which is you mentioned privacy, and a need to be careful about filming people's faces and keeping lives private. What kind of issues face drone technology and the industry at this time? This could be technical, regulatory... How is the industry working to counter this and what ethical principles do companies or your company embrace and use for themselves when it comes to design, use, and application of UAVs?

Ok, so we – starting by the end – we do not develop UAV and our software basically do photogrammetry of composition of images based on the image it provides. So, we do not, we are not extremely concerned about designing of software, at least at this stage, our goal is about recreating 3D or 2D maps and models, so this is not something that we are concerned about, it is more something UAV manufacturers will have as part of their models. Now, it's also about the sector code of ethics in the applications in the field about when to fly, where to fly, how to involve, inform communities before doing it, and then who has access to the data, especially in fragile contexts you want to make sure that the data doesn't go into hands that it should not because it could put people's lives, communities at risk as well. So it's one thing about having a good corpus code of ethics, it's another things about applying it. Umm and that is really important. So, the privacy, we know it is a concern even though in our European countries or anywhere, as machine learning, whether from China, to Brazil, and you've heard – read about so many reports about people being identified as well, or managing mass movement, crowd movement, this is more something that we need to be careful of or the community has to be careful of about even more vulnerable communities, either that fled or at risk, so this is an area of concern in terms of data acquisition and data management and transmission.

And in terms of this, who is responsible for ensuring this privacy and security? Obviously we would expect companies individually to provide the basic security, but are there

regulations in place or should there be? and is it chiefly right now up to the individual company?

I don't necessarily believe that it's up to the company to define the regulations specific to the humanitarian context, this is – companies are typically commercial, may facilitate, discount, or support specific applications for it, but fundamentally I think that it is something that humanitarian organisations need to take at heart, it's part of their code of conduct. They do it for non-UAV applications, this should not be an exception, it's not because it's something that flies and that someone can manage, and communities might not even see that it's flying, that it should be exempt from any rules and regulations. More fundamentally, it is something that if NGOs, humanitarian actors in the field do not implement will be driven by more global actors, whether it is a donor community or supra-national associations. The worst case scenario is that each government dictates with their own laws and regulations which will become a real jungle of application as well, because it will be driven by fear more than by opportunity.

So just to stay on this line, to your knowledge, is there already in place somewhat of a standardised regulation or does it change a lot country to country?

I mean, even in terms of civilian drones, there is not yet one standard regulation, so imagine about humanitarian context. So, I think we are far from that. It's moving, it's moving fast in some countries, typically Switzerland is at the fore front, now basically there is a an association of countries looking at standardising drone regulations, but it's not there yet, so if it's something that countries that are experiencing the full-fledged applications commercially or not drones, shall help to develop other countries, developing countries or countries of the South with these types of regulations. So countries have a big role to help others come to the same, otherwise there will be abuse.

Do you see a role in international organisations doing this, or how would this occur?

I mean obviously it will be either international organisations or governments. So, typically, I think because they were really by far the pioneer, you may have come across this code of

conduct, by drone aviators UAViators, which WeRobotics was amongst the pioneers behind it. This is something I do not know how widespread it is being applied, how specifically targeted it is, they would be best to respond to this.

Would you say that UAVs are increasingly present in society? If yes or no, what factors do you think are behind this?

Well yes, clearly yes, we see this by the numbers of growth of sales, just one because the access in terms of simplicity of use has increased immensely, it is not complicated to fly a drone, it is a few button and you fly it with more or less risks, and the price has decreased, so you can really get a drone – and when I am talking about UAV, real and serious UAV for good applications is not tens of thousands of dollars anymore. So price and usage have both become more simple and cheaper, which made the usage more democratic and accessible.

Where would you say they are increasingly present?

You have a very important usage in specific fields, such as construction, agriculture, basically surveilling, that's a primary sector, and one of the biggest growing sectors right now is public safety. So public safety, basically, is one area that is growing fast because helicopters are expensive and planes too [inaudible] to contract and you can easily deploy a drone from a police trooper car or a firetruck or an ambulance to search for people, to assess fire damage, to do accident reconstruction, so the number of applications are numerous and the costs are lesser than big heavy equipment.

What about locations? Are there any particular hubs of integration of drones, or is it quite widespread for the moment?

My understanding is that it is quite widespread, in terms of, obviously Europe, China, North America, South America is growing fast as well, Africa you have hubs of growth, typically they are investing Malawi, [redacted] was supporting that as well for a part, Zambia, and so some

countries – Tanzania, sorry, not Zambia – have really desired to invest in the technology, although sometimes those have limiting restrictions, I mean India is a growing – will be a growing country obviously. Other countries are limited by legislation.

And what kind of timescale would you give this increase?

Personally, I am not in the specific UAV insight, I could not tell you, this is something a manufacturer would have a better outlook on.

Could UAV integration in humanitarian missions create dependencies?

The biggest risk yes, it can. The biggest risk is that if local capacity is not developed, if it is a response which is external to the countries, needs to happen to require to gather data and asset then it will require dependencies. And that's why investment into building local knowledge and capacity to manage it, A to be faster, more efficient, and more culturally sensitive to the context, and also drones are just a component of an assessment or a health response, it is not the full solution, so people coming with no knowledge of the context or less understanding of the context and application may create more risk and dependency – local population dependency because their business will not have developed as it should have.

I've come across this in some of the public discourse around drones so I want to ask you – is the drone a revolutionary or turning point technology? Why?

I think we can argue both to be clear – I will believe it is revolutionary in terms of the UAV drones because you can get a viewpoint that you will never have had otherwise, or you will have had to buy it, contract it, at a cost that nobody else will have been able to afford. It's also provide an outlook on any given situation that was simply unreachable before and technically everyone, you and me, can get this outlook. It's not reserved to an elite group so it is really democratisation of a technology of solution that basically was reserved to an elite, very select few, where now it is made available, so I will be more bold towards real technological revolution.

So would you argue that this kind of language is present in the discussion of drones, generally speaking within the industry, or is it reserved to media and more of a public facing front?

I think it's not in the industry, the industry is now basically just working at providing the best solutions, it's not even looking at it as revolution, the revolution happened. Now it's about improving and adding and enhancing and making it, you know, longer flights, obstacle avoidance, it's more about futuristic building on this big big thing that happened ten years ish ago. So now, in terms of the public sector, the media, I think there is still a huge misconceptions about applications of drones, it has quite a bad image. We saw because of Gatwick and other airport, and privacy breach, you name it, terrorist attack, whatever, so basically it has a bad image. So right now it's not even looked at as revolution, evolution, or improvement it's more looked at negatively.

I want to pursue that a little bit. You talk about a negative image, could you expand a little more on this?

Well like I said before, unfortunately the, the highlights of what a drone could be used at negatively gets media attention more than what it can be good, used professionally in the sector, or by – yeah, whether for construction, engineering, public safety, agriculture, you name it, this is what people do on a day by day basis but then you will have one or two or a few people that use it for less good applications and that gets people's fears up, media attention high, and that attracts basically and on which governments may restrict applications and usage. So it's unfortunate, there has been, clearly, I'm sure there has been abuse, or unwise drone applications in the early onset of this technology, but a lot of rules and regulations are being put in place so that it can be used in the best context.

So from your point of view, from what you've experienced, there's been a tendency towards negative views of drones of this kind of new technology?

Of the public yes.

Is there any link between that fear and media portrayals and the military applications of drones?

I mean clearly, this is – when you talk about drones and contexts, I will suspect that a lot of people think about military and weapons first, I mean, companies like Parrot, DJI have helped to make drones much more visible, accessible, to wider public, but in a lot of contexts, and we are thinking about Europe, North America, South America, but in other countries the primary use of drones is military and strike weapons, especially the humanitarian contexts. If you talk about drones in Sudan, South Sudan, Afghanistan, their understandings of drones will be different than what we have as a toy, or leisure or hobby, or professional application, so it will depend who you ask for. I will say no context, a lot of people still think, maybe not consciously, but maybe unconsciously, about military applications yes.

So would you describe this negative feeling as a fear of some sort or would you use some other kind of word?

Not necessarily, I will not necessarily go towards fear, but simply, not necessarily think about other types of applications, I would say it's a lack of knowledge.

So it's still too new?

New, lack of education about other applications, yes.

The UN has suggested for humanitarian drones to be painted in different colours than say a Predator drone or a Reaper drone, now – what kind of effectiveness do you see this distinction having? And do UAV manufacturers who are civilian facing, who are maybe humanitarian facing, do they need to distance themselves from the negative images of military UAVs and how could they do so in your view?

Ok, so for the first questions about the colours, hmm, frankly try to identify a drone at the altitude it flies and say civilian application, military application, good luck, so unless it's landed and you can see the application, but then you can see who is the pilot and you can talk about the intent. First it needs to come by talking to the communities you will fly over, that is the primary purpose and requiring the right authorisation to do it, you cannot force it on people. I think colours is more cosmetic, and I don't think it's primary, first thing. Secondly, about drone distancing, unfortunately military applications have driven civilian applications, so this technology has already really helped to be where we are now in terms of safety, security applications. And again, define the military applications, in some countries police, public safety is part of military units, so there is very much of a grey line about it. About creating weapons of war, I have my personal preference to say I would personally prefer not to be associated with it, clearly, but then it's about company decisions and I'm not the one to be the judge, to judge on that. I know that as a matter of fact [redacted] does not develop military grade or military applications, but yes we do sell end-software towards public safety and emergency response. So that is something we are focusing on, it can contribute to good, and make the world around us safer.

I've seen a lot in readings, especially in the early 2010s, you had military companies themselves trying to distance themselves from the negative attitudes, for example by rebranding or promoting these civilian and humanitarian applications for drones. Is this ongoing or has it taken a life of its own?

I'm sure it is ongoing by subsidiaries and others that are basically doing it, but that is not something – let me rephrase it, I am not sure, I guess it is happening, but that is something you may know better, I do not have the insight on that.

Ok, because yes I saw companies or associations like AUVSI in America (yes) and in the UK it was AUVS (yep), they seemed quite active in trying to rebrand the drone integration and movement, so yes...

I mean USR basically do, try to do a lot or role of educations and explaining what drones are about and it's multiplicity of sectors and applications, but then you have specific trade fairs and aviation weapons where you will have very specific manufacturers that are not necessarily present in those type of generalist, I will say professional, associations. They will really be restrictive – if you go to Le Bourget, or specially wepaons fairs which we are not part of, but weapons fairs in Dubai or other area, this is not necessarily the same manufacturers that are mixing, mingling.

Relatedly, does lobbying exist between the UAV industry and governments, and/or NGOs?

What forms would it take?

Uhh between that and governments I do not know to be fair, I do not know. There's certainly some that happens, but I will not have any specific idea. With NGOs, I don't think there will be what we can describe as lobbying, I think there is a lot of testing research and trials, and collaborations, and I really mean it in terms of collaborations of providing free or pro bono, or low bono applications in our context, because we know that actually the goal is not about revenue and commercial success, it's about doing something good, so typically when a big large scale crisis happens, we are quite likely to give licenses and expertise if it helps. We don't advertise about it, we don't talk about it, but if it helps the community, the humanitarian community, we may give it or offer to give it. That was Mozambique flood, that was Malawi floods, that was – but that's not necessarily humanitarian, when the Genova bridge collapsed we were able to also provide licenses or data set, so it's just a mindset, it's about collaboration. If it also helps to contribute the humanitarian community to see that there is usage and there is good application they can do out of it, good. But for that we've got to make sure that the applications will be good as well, we don't want to just give it to anyone, we want to make sure they can use it responsibly, and do good out of it. But [inaudible], I don't know if there is dedicated lobbying towards it.

How would a legitimization of civilian, social, humanitarian applications for drones affect state use in military and security fields?

Can you repeat please?

(Repeats)

Well in an ideal world, which we are not in, it should not be linked, clearly, but it is not, it's so fundamentally different in terms of infrastructure, skills, all, I do not necessarily see the legitimations behind it. Unfortunately, people may try to find ways to do it, but I don't have any sort of practical case or situations where I would see the direct correlations.

Because, one could argue that having a drone in the public, you know, flying around for deliveries, or some inoffensive reason, that might get people more educated as you said before and they might be more aware of drones, more comfortable around drones, and these drones could be used in different applications which could be used negatively, for example in military and security fields.

Exactly. I mean security fields, the types of drones that are typically used are quite more heavy duty than what you would use for civilian, their altitude will be different, their camera lens will be different, it is quite likely that you will not hear, see, or notice that the drone is flying over you, when for civilian the altitude, the range, and the – I don't think it is necessarily comparable. Yes, there could be some links about making the population more comfortable about it, but I – maybe I'm naïve but I don't see necessarily the links.

And you mentioned before – what are the synergies and learning effects between the military side and the civilian side of drones?

Yep, I mean especially in the early time, clearly, when you thought about drone technology, it was clearly military in terms of the lead but the civilian capacity has increased massively in terms of R&D, and yes there is maybe things to learn from the military in terms of lens precision, etcetera etcetera, but I think the technology has advanced and capacity has advanced quite a lot recently. That necessarily – now military may look at civilian drones because it was a different

work stream and work flow who achieved different results, to see how they have applied it, because the applications are different, fundamentally different. And civilian drones do not need the same autonomy, range, control, than you would have for military, so it's a different mindset.

Would you say that today, there is an impact of the military's objectives on the civilian sphere's or domain's objectives for the research and development of these technologies?

Honestly, I don't know, I would not be able to do a correct correlations and links, so I prefer to say I don't know.

I have been reading about the 4th wave of industrial, or the 4th wave of technology, I don't know if you are aware of this. (affirmative response) I find this quite interesting. What do you see as the drone's place in this new time?

In terms of machine learning and artificial intelligence you mean? The drones will basically play an important, it will have it's place in there because – not necessarily the drones but the image and the insight you can get from it, so it's not the drone as the manufacturing piece, the hardware equipment, but it's the contribution towards machine learning. Typically, to monitor projects, to assess land usage, to see vegetation growth, yes you can count manually to look at livestock but machine learning will be really able to help report, predict, assess, and this is really something where a lot of insight, extra layers of humans will have required years to achieve, will be able to be done more simply by machines. So more the outputs than the hardware itself.

Ok, so the outputs of drones is what's going to be particularly interesting rather than the hardware itself?

The hardware is more of a means to achieve it, yeah.

I always struggle with his name – Brynjolfsson - argues that in the first and most prominent seller, or what he calls a technology superstar, of a new technology gets the

lion's share of the market. He gives the examples of Apple, or Google. What relevance do you see between this statement and the drone industry?

I mean clearly, the one which has the biggest market share in the drone industry – civilian – is DJI, and by far. It has, it's experiencing quite a lot of challenges, especially in the US about data privacy, and access to information. Misconceptions or truth, I have no capacity to judge, but that's basically something that they are trying to advocate, they are processing things based on rules and regulations, so currently they have the market share, but lions can grow and explode as well, no bad analogies, but ehm, technology grows fast, if they don't see the turn in terms of technology applications someone else may supplant them. Nobody knows yet who and what, but we know about companies that were the primary market leader and do not exist today, so that's, drone technology should not be exempt to that at any stage

Hmm actually DJI was – the other expert that I have interviewed so far – also suggested DJI as the lion in this metaphor, and he compared it metaphorically as the Apple of drones, because it really brought civilian drones to the public sphere.

It's actually interesting because Parrot, I think I believe was earlier in terms of usage, applications, and – but then DJI had the capacity, lower basically paid manpower, more staff, more capacity to bring the price down, and they truthfully brought the price down in terms of democratisation of drones and UAV, and now is focusing on professional business developments because the civilian market is saturated. So it is fundamentally a different context, so lion, but as any company, if you don't reinvent yourself, what will be tomorrow?

And, would you say this position of DJI's, the Apple of drones in the public sphere, does this create dependencies in the industry and the market? Does this affect the relationships between the manufacturer and the customer in any way?

It can, I am a believer of real healthy concurrence, so if you just have a situation of monopoly it is not healthy for anyone, and it's not helping for innovation, so you need to have contenders, not minority or large or small minority but good contenders that can challenge you and that can also

provide choices and alternatives for customers. So, I think it is necessary, and it's not healthy for one to dictate the entire environment.

Seeing as we are reaching time, I will ask you a very open-ended and speculative question – what future do you see for the humanitarian drone?

A drone just for humanitarian or just the context in general?

Context in general.

I think it's going to be, it's going to evolve, to grow, clearly not at the speed than it was predicted, maybe five, or maybe hoped for two to five years ago. I think there is major progress and great progress in coming back to local community, it's because they get – are getting access to this technology and they are finding different and more creative ways than we are maybe even thinking about, and that is great and amazing to see. So I think it's going to grow, it's – the applications and the diversity will be unexpected, and I'm looking forward to that, yeah.

Ok, great, thank you very much.

7.3. Appendix 3: Head of Academic Relations, Company with Ties to Drone Start-ups

Note: audio quality was lacking at times because of the connection quality, efforts were made to limit the impact of this but some words remained undecipherable. These have been marked throughout.

Q: Could you please give me your full name, title, and your position please?

Yes, I am [redacted] I am the head of academic relations at [redacted].

Q: Could you explain in what ways does your organization interact with UAV technologies? What type of organization are you? What locations do you operate in?

Yes, so we are a science and technology consulate based in [redacted] and operating in the east coast of the United States, as well as the Eastern side of Canada. Our mission is to connect with stakeholders in education, research and innovation and the Arts between Switzerland and the geography in which we operate. And while in the last year we have not worked much in the U.S. space (?), we did run a programme called [redacted] which I had launched in September 2017 at some point, as a focus area for [redacted] for our activities essentially recognising that Switzerland is one of the places with a substantial domain expertise when it comes to drones across the board, from the technology side, from the research side, from the policy side and the regulations side; there is an enabling environment that has made it attractive for start-ups such as Matternet, from Silicon Valley to set up shop in Switzerland and they were allowed to fly... for the swiss post to do testing on drone deliveries at a time where that was not possible from a regulatory perspective in the U.S. And then you have the Institutes of Technology, EPF Lausanne, ETH in particular that came out with a number of start-ups that gained renowned and ... we have seen that there was essentially a critical mass that spanned across the various disciplines, and as an organisation that is interested in creating opportunities for Swiss stakeholders in education, research, and innovation. We thought that launching an innovation focusing on Aerial futures, and drones in particular, was a good way for us to build our visibility as [redacted] and to serve the stakeholders in the drone sector in Switzerland and to give them more visibility and to create opportunities for them to connect. And so, when we launched that, I think the first official activity was going to South by

South-West, and ... I guess, April or so of 20, March actually, March of 2017 where we ran a panel discussion on drones in entertainment with Varsity Studios, which had collaborations with Cirque du Soleil, with Metallica, and other bands playing shows with drones embedded within performances. And then from then on we've done numerous other activities, and as the initiator of the series, I was involved in one way or another with everything that we did and as somebody who has an interest in the development world and the humanitarian sector, those were areas that we got to focus on early on bringing a panel to the United Nations at some point, to the Science, Technology and Innovation Forum looking at how drones are used in developing countries. Enabling a whole suite of activities that are otherwise very prohibitive to get because of cost, because of lack of resources and technology to do them - from mapping; to better planning for disaster recovery or preparedness; to using UAVs for taxation purposes; or conservation, nature conservation, there's a lot of potential and a lot of use cases for deploying UASs, and wildlife conservation. And then also in responding to humanitarian disasters, like the earthquake in Nepal or hurricanes in the United States, a lot of good use cases for the technology there and again a lot of interesting developments coming out of Switzerland. And then we've done a general showcase of pretty much the whole gamut of the Swiss drone ecosystem inviting numerous of start-ups to participate in Hub Week which is a Science and Technology festival here in Boston that used to run annually where we participated with a focus on drones. And then we've done a larger ThinkTank last year in April here in Boston on the third dimension, so urban air mobility. And there we convened about thirty experts from across the US and Europe, across disciplines, so we had regulators [audio drops] ... who Uber elevate, we had academic researchers that are doing the modelling, we had somebody who is doing research on Urban turbulences, so how to build environment affects wind and how in turn that will affect UASs both thinking about mobility - flying people - and also flying cargo last mile delivery and having this group of very broad disciplinary expertise come together and discuss various aspects of Urban Air Mobility in a ThinkTank format was a really good activity. And then we supported the Swiss Embassy in DC right after that, also in April of last year, with an activity looking at digitising air space, so this was a focus for the FOCA (Federal Office of Civil Aviation) and the FAA, the American Federation Aviation Authority. And that has since led to the signing of a letter of intent that was signed I believe at the end of May or June, one or two months ago by the two agencies to

collaborate in Airspace integration of UASs in particular, so I think ... that is in a five minute summary or so, of everything that we have done in our Aerial Futures series.

Q: Ok, so it's quite - if I have understood correctly - it's quite a global span of activities, and primarily in research and raising awareness around this new technology?

Yes and No. The visibility and the raising of awareness was very important, but the outcomes that we were going after were opportunities for collaborations. So if it was a Swiss start-up, helping them find clients, find investors, find possible incubation spaces depending on what stage they are at. And there's an incubator in upstate New York called Genius NY that is actually a specific incubator/accelerator for drone start-ups. And so it was very useful for them to have those connections. In the case of the Federal Office of Civil Aviation, it was about establishing formal relationships with stakeholders in the US that have led to this agreement, but also there is trade conferences that all of these people go to, so then the ... the Head of innovation at FOCA was really excited that the Thinktank put him in front of people that he would normally not have had an exchange with and that he had those perspectives to incorporate into his work. And so there, our mission, or our objective, was really to bring a cross-disciplinary thinking to inform and drive important conversations that will then lead to the policy memos and the regulations, and the design of drone ports or the drones themselves that will fly citizens.

Q: Ok, great. So, to move along the questions a bit closer to my particular research area: In what ways can you see UAV technologies being involved in health related, social applications?

erm...

Q: Or humanitarian and social health applications. Anything that would be...

Are you looking for a specific context, or are you looking like in the developing world, or globally? So you're agnostic to the geography and context?

Q: Yes, for the moment I am quite open to localities, I am just looking for quite a broad definition, but if you have any, for example any cases where you are particularly involved, or you think are maybe in development - those would be of particular interest.

Yeah, yeah, yeah. So ... Well... And you are looking in the health sector in particular, right?

Q: I am looking at humanitarian cases, and to focus within those I am looking at anything that may be health related. So one that comes up a lot for example is Zipline's use of drones to transfer blood across countries.

Yep. Of course, along those notes there is a drone creator in Malawi and now the first drone creator in West Africa, in Sierra Leone which Unicef has established and these are sort of innovation zones also looking particularly at the potential for delivery. Now in the humanitarian disaster context we have seen drones widely deployed after the earthquake in Nepal. There's a number of use cases there: its eyes, eyes above ground that allow for a rapid assessment of a situation, and you can now equip these drones with all sorts of sensors and cameras that can for example if you have a heat camera you can find dispersed people that may be covered under debris. Now you have tiny drones that you can deploy into say environments that are not safe for humans to go to, like a collapsed building and again with sensor you can collect all sort of relevant information that has an immediate humanitarian use case. With Covid, I have heard conversations of deploying drones to sanitise large public spaces, or generally robotic solutions that can be used to disinfect large areas or areas where you don't immediately want to send people, so again a humanitarian use case. But, I would say yes. The two general use cases that come to mind is: delivery, so delivery of in Zipline's case it is blood samples, or not samples but blood, and that can be rapidly [inaudible] or medicaments or other supplies that may be needed in a context of crisis so that's just delivery per se, and what's interesting in the context, well perhaps not in the context of Zipline but drones in that case, is the distinction between middle mile and last mile, because a lot of the conversation on drone deliveries in the context of developing countries, in Africa in particular is the middle mile, road infrastructure is poor and so you can essentially bypass roads over longer distances by flying cargo, but then the last mile, deliveries are actually a very important economic opportunities and source of livelihoods for a lot of people cos the last mile delivery is a guy on a bicycle and a motorcycle that does that last bit of delivery and so eliminating - using drones to replace those is actually a negative implication so that might be an interesting element to look at also in the context of humanitarian crisis. And then, I mean there's - when we're talking about drones there's UAS, Unmanned... you're just looking at aerial systems, right? Not looking at underwater, or...

Q: No, but please feel free to talk about those as well if you have something that you would like to talk about. I am happy to hear it.

I guess I don't have a direct use case in the humanitarian context but there is a lot of potential - actually yeah, no there is. Pandemic. If you can deploy a drone as intended as an automated system, say in the sewage system of a city with all sorts of sensors that allow you to gather information that can be both predictive of possible spread of diseases and outbreaks, so ... What you can find in sewage, the information that you can find in sewage can be very very relevant and I know there's the Sensible Cities lab at MIT has a project on that called Underworlds - and that is looking at the deploying sensors. I don't know if it is drones specifically or if its just fixed sensors but that is essentially like taking the temperature of a city by looking at what flows in its sewage, and what kind of predictive information that you can get and in the context of a health emergency like the current one there could be some use case there. I think of the top of my head those are the ones that come to mind.

Q: Ok, thank you. So, would you say UAVs are increasingly present in society?

Absolutely.

Q: What factors do you think are behind this?

Cost reduction, ease of use, accessibility - are particularly, I would say, the most common. It's actually very interesting, I was - what was I watching? I don't remember where but just in the last few days. If you ask people what they associate drones with, or if you asked that a few years ago the first response was immediately: wartime, and drones are weapons or are used as tools to deploy missiles or whatever, and to do surveillance and reconnaissance. And so the whole drone ecosystem to this day, but I would say moreso a few years ago had this very negative connotation because that's where the technology came from, that's sort of the civil and commercial use of drones as a branch out of the military use of them. And if you were to go around and do a survey today, I think you would have a different answer, in the sense that "oh drones are those cameras", cameras that you can deploy and get aerial shots of things. So I would say that is the transition to the commercial use of drones, or the recreational use of drones for people who can use them as just toys and gadgets has significantly contributed to a shift in both the perception and in

popularising and giving them a large market. because it is not the potential of using drones to inspect infrastructure for example that makes them widely known.

Q: So particularly civilian, recreational availability is what has changed this image and moved it away from the military and the more negative connotations?

Yes and then, in general it is that, but then there is specific moments that are not necessarily civilian use but that, you know when you see a video of - I forget, I think it was IBM - that did the drone swarms aerial performances as an alternative to fireworks, then I mean you know and something like that goes viral or when you see a video of a Metallica concert with the drone show in the background, or what Variety Studios did with Cirque de Soleil and they produced a short film with drones as lamps and using them in these creative settings. That, things like that can have a broad reach in terms of audience contributing to the change of perception because they are very visible.

Q: So, sorry. Was there an industry or a manufacturer based push for this separation from the image of the military drone?

I'm not sure that I know the answer to that question, but I would assume that there was.

Q: Ok. How long have you - I should have asked this at the top - how long have you been working with UAVs?

I guess my first, first interaction in this space was in 2016 with the Redline and Blueline project coming out of EPFL in Switzerland led by Jonathan Ledger, looking at drone deliveries in Rwanda, particularly the establishment of drone ports and the network of drone ports as community centres for economic activity and the use case of drones and delivery. And I know Jonathan has been instrumental, or has played an important role in both informing the thinking of President Kagame and in some way I believe also with Zipline cos he was the chief correspondent for The Economist on the African continent and then turned futurist/technologist.

Q: So, yes, what I wanted to link that to is: you responded immediately “yes” to an increasingly, an increasing presence of UAVs in society. and I wanted to know: what kind of timescale would you describe this as? Are we looking at five years for this kind of change? Or maybe ten? Twenty?

That is a really good question... I mean, definitely in the last five years but that is mainly because of my interest and my awareness of it has changed professionally, so if I were to say that it has drastically changed in the last five years, I may be overcompensating because it has drastically changed for me because I went from zero to some knowledge. But I would definitely say that in the last ten years we have seen a dramatic rise in the use of drones in non-military environments, to the point where you can now spend a day outside in a park, in a city and there's a chance that you will hear the familiar buzzing sound of a drone flying above your head. And I mean, in my context I would say this has happened, and its not allowed to do from a regulatory perspective it is forbidden, but it has happened at least ten times in the last two years where I have been in an environment where I hear a drone, and it wasn't related to some activity that I was involved in where I knew, or I was involved in scheduling or planning the presence of a drone. And then in terms of you know, viral videos on YouTube the availability of having incredible footage of events and activities provided by drones has significantly contributed to the awareness, where the drone itself is not the thing that it is about, but it is the medium through which you can see something. That has really increased significantly because we see a lot more aerial imaging that before would have taken a helicopter or a small airplane or a very powerful satellite or something else to collect. And I think if you were to do a study of charting the increase in aerial imaging both in photography and videography I mean, in real estate for example the impact of being able to hire a photographer that has a drone to take photographs of a property that goes for sale, the value added increased tremendously because now you can include an aerial shot of a building or a property that you want to sell, that before was very expensive to get because you had to get a helicopter.

Q: Ok. And I would like to go back to your point about the military -- sorry, family... I have to live at home, so it's the family in the back, hopefully someone will pick that up quickly -- in military applications the drone has become infamous with, and associated with signature strikes, death, general ... we'll say a lot of negative things. There has been sort of a push to separate the civilian or commercial drone from this image. And the UN warned that humanitarians should try to for example demarcate themselves using colours, you know bright colours on drones. Is this demarcation, and really a demarcation from the military image of drones necessary for all UAVs? And what can manufacturers do to make this happen?

That is a very good question. I actually know the person that was in some way involved in this push, and there's a few people at the end that I can recommend you also interview who are more knowledgeable than I in this, and she is one of them. And I guess it depends, this bad reputation that drones have being associated with strikes and surveillance. And I mean with surveillance here in the U.S. context now too we have learned that drones have been deployed to surveil cities during the recent social protests in the Black Lives Matter moves and the protests against police brutality. And that is disconcerting but these are drones that fly beyond the line of sight so you don't even know that they are there. And so, that's in the context of the U.S. is it particularly important that you distinguish? No, I would say generally no. As a matter of principle, yes; but as a matter of is it practical or will it make a difference for the population, no. It would help raise awareness to the population so more from that perspective than the actual practical perspective. But then in other contexts, where these signature strikes, where there is real trauma associated with this technology, I believe it's much much more important, and those are often those environments where deploying drones for good can make a difference. And so having the buy-in of a local population, or having a local population understand the distinction between a "good" and "bad" drone is very important. And very important even in areas - you know I've done some work in Zanzibar and there's the Zanzibar mapping initiative, very very populous, the largest drone mapping initiative in the world. I wouldn't say its a humanitarian drone application, its more of a development application because they had to update the maps of the two islands of Zanzibar and it would have cost a couple million with airplanes, and they were able to do it for under 200,000\$ using drones, training local drone operators and sort of building a little, local drone ecosystem and capabilities around that which was very good. And I know, so they had to fly drones not beyond the line of sight, so these are EBEs from Sensefly, so these are fixed wing drones that fly above the sky and you can see them and you can hear them. And so you had to get the buy-in of the local population, and you know Zanzibar is not a place that has seen drone strikes or has seen first-hand the surveillance or striking capabilities of drones, but it is a place that still is not far from - culturally and geographically - from other places where that is more sensitive, where that has been seen, so it was very important to get the buy-in of the local population and have them A) understand that these drones were not there to surveil them and were not there for any negative purposes so that they shouldn't shoot them down or destroy them because these are very expensive pieces of equipment in a resource constraint area. And so the way that they went about it was

starting to work through the school system, showing these drones to kids in schools and presenting the project to kids in schools; and then encouraging the kids to talk about it at home and essentially using kids as messengers but then also having community gatherings and moments where the community could familiarise themselves with the technology, ask questions that they had, but very important. And so if there was a way to make this universally recognisable so that at any point you know, if you can see it and recognise: ok this is a drone that is used for good in lets say a humanitarian purpose or humanitarian mission that could be very important. But of course it is something that can easily be abused by anybody with ill-will.

Q: You mentioned here the community as a stakeholder in drones, and we're seeing a lot of companies moving towards community based ownership or running of drone programs but there exists a whole host of stakeholders, we see state-owned drones, we see NGO-owned drones and privately-owned drones of course. Is there in your research or in your mind an ideal stakeholder for the drone? Do you favour a community based program, or is it maybe better in the regulatory hands of the State or somewhere a bit more flexible like the NGO?

Well I would think in general, I'm a proponent of the freedom of everybody who wants to have access to the technology to use it and in order for that to be viable all of the different stakeholders need to come to a common understanding so I don't think that there is a single one that is more, better suited than others. I think there is a case for using drones commercially for various purposes whether it's delivery, whether it's analytics, whether it is human cargo or other cargo. I believe that there is a use case for the use of recreational drones, but of course there is, ... all of this has implications, it has implications in ... like if you want to fly it in an urban area, this needs to be regulated. It has implications on people around you who may not want to have a drone equipped with a camera to record their property from above or people hanging out in their backyard. And so it is the common understanding that is generated at a societal level by all of these stakeholders. I mean, you know with cars it's the same thing, you know with drones you know you can see a lot of analogies with the introduction of cars. Nobody today questions cars' ability to do what they do, which is drive around and it is geared towards freedom. Is there a specific stakeholder that should, is best suited to handle cars? I would argue no. Anybody who passes a certain threshold of hurdles should be free to drive a car and there is public infrastructure that is paid for by taxpayer money to drive cars. Drones don't need that and there's no need to pave roads, but there are

externalities. Cars make noise, drones make noise. Right now, the noise conversation is an important one and that is just pushing the developers and technologists to come up with ways that can make them quieter so that they disturb less from a noise perspective and that will definitely help with acceptance in certain contexts. But I would say that overall its ... freedom, individual and collective freedom, should be the principle objective in this. And that can be the freedom of me to operate a drone if I want to operate one, and that can be the freedom of me to not being bothered by a drone if I don't want to be bothered by it. It's finding the sweet spot there.

Q: I do want to link it to one of my preset questions but this does invoke something else. I was reading earlier about a DJIs possible ban from the U.S., and as someone who works across borders with drones, how would you feel a ban like this would effect your type of relationships across borders - with start-ups, with different companies? Do you think it would set a precedent, maybe?

I mean.... For me, in my line of work it would have no impact because DJI is a Chinese company and the stakeholders that I serve are Swiss stakeholders and they often manufacture their own technology. And so from that, no implications on me, and I think this is more part of a geopolitical relations between the United States and China and this is upon one small element of that, but I honestly don't think that this will have a significant implication for the sector as a whole - and just like these policies can be implemented one day, they can be changed the next day. So... I wouldn't ascribe too much weight to it, at least not yet.

Q: Ok, so you don't see a possible future of a politicisation of the drone? And maybe the drone's origins or the origins of the manufacturer?

No. Politicisation, yes; but not around the manufacturing. I mean, it is possible, we are seeing this with the 5g technology that is being very politicised. There is the push for the American-European, I mean America wants to push its own take on the technology also upon European stakeholders and reject the Chinese, which I believe at the moment have the most advanced capabilities and perhaps the most cost effective, but of course that comes with a significant risk - I mean that's the argument, it's the surveillance. Are we going to be, you know, Iphones are manufactured in China, its an American design technology... Are we moving towards a future where the Iphone will no longer be manufactured in China because there's a risk that they could embed something in there

that could allow you to spy on it? No, I don't think so. I think it is, the aim is to hurt in targeted ways, so Huawei and the significant stake of the Chinese government in there. I don't know what stake the Chinese government has in its drone sector, but I think as a market share it wouldn't be hitting them where it hurts - much more so with the case of the 5g technology, but I may be wrong. I think it is more of a matter of how much can you hurt a country or a stakeholder through those measures, and then it is at risk of being politicised. I think the drone market globally still marginally important in that sense, I think there are other sectors where you can do a lot more harm economically, with such policies.

Q: Ok, so the preset question now: could a UAV integration into humanitarian missions create dependencies?

Yes. I would probably say it could, it probably already does.

Q: Could you please expand on how that occurs?

And... I guess I don't have any direct evidence, it's mostly my assumption or inference based... But essentially, drones are a technology that requires a certain skillset to be operated, and in a humanitarian context you may have to reach an area where there is a humanitarian emergency and you may not have a supply of people with the skills, you may not have the technology itself, you may not have the drone and the people who know how to operate the drone so you have to import those. And we have often seen how, when that happens, the people who show up tend to be white men, and they come, and they do their mission, and there's no knowledge transferred, there's no capability necessarily built at a local level, and that in and of itself is laying the foundations for a form of dependency, because then of course the humanitarian emergency may continue, or may get worse and you may need it again and again and its going to be very expensive to fly in a technical expert with the equipment, and actually one of the two people I am going to recommend you reach out to is [Interviewee 4] who is the co-founder of [redacted], I don't know if you have come across...

Q/ I have attempted to reach out to him, but I think he is busy at the moment.

Alright, I'll send him a WhatsApp message later and ask if we can make something happen. He's definitely somebody you should speak to, and if it's not him then he can suggest someone in his

team. But essentially he created [redacted] precisely for that purpose, to localise these robotic competencies and ensure that whenever there is a crisis there is somebody local that can be hired and there's somebody local that knows how to use the technology, that has access to the technology and that you can spin-off a small industry around that because of course you know the nature of humanitarian crisis is that they are transient not permanent; but the use case for drones is more permanent, so what may start as a humanitarian crisis can then morph into another use case that is perhaps more development focused and more focused on generating economic opportunity and then that's the analytics, the intelligence, and you know we've seen that with the mapping and some other pieces. There's a West African start-up from a Sierra Leonean founder based between I guess Sierra Leone and Nigeria called Track Your Build that is looking at using drones for construction purposes, so tracking construction and then optimizing the flow of construction projects. So you know use cases like that can emerge out of humanitarian missions and the technologies and capabilities remaining local.

Q: Ok, - just I am aware of the time, so I would have liked to ask more questions about that, but we'll move on to the last one -

I have ten - fifteen more minutes if that helps?

Q: Well I was just interested, you brought up the fact that it's mostly white men who come to help in these humanitarian missions, and you spoke of knowledge transfers as a way to - would that be a way of combating these dependencies by localising more? Is that -

Absolutely. I'm a firm believer, and I think the work that WeRobotics does in that context is very important, and the results that they are showing are incredibly important. As part of my Masters thesis research I spent some time in Sierra Leone and was able to help get the Sierra Leone flying labs off the ground, so connecting WeRobotics with stakeholders there. And again it is not the result of a humanitarian crisis necessarily but it was more, again, localising that expertise. And I was just on LinkedIn yesterday reading a blog post from WeRobotics on how they did a mission in November last year, and the mission was not to fly them but to go to schools and to show them this technology and its capabilities and its potential to kids in school to entice them to pursue STEM careers and to show this as a viable career opportunity for them. And I think, you know, you work across a scale, some of it is more long term and that's the talent pipeline, showing what

the possibilities are and there you need talent dedicated in STEM; and then there's the more immediate use case where you can do a mission, and having those capabilities. And Freetown, you know, its the rainy season, July-August is the peak of it and they had the massive mudslide a few years ago and again having aerial intelligence that you can rapidly deploy in the context of a mudslide that killed, I believe, a thousand people or more, is very important.

Q: Ok, great. So we will move on to the last question: how would a legitimization, or how does a legitimization, of civilian, social, humanitarian, etc. applications of drones affects the States use of military and security fields? Is there a relationship between those and the way these are viewed; and are there synergies or maybe mutual learning effects between these military and civilian applications?

I think so definitely, because the military applications are not purely tied to warfare and surveillance cos the military is also involved in humanitarian missions, and so the military is also learning from the humanitarian world about what the potential of this technology is, or it can be itself contributing in that case, and then ... I have been involved for years now in humanitarian disaster simulation training, and one of the people I recommend you reach out to [redacted], she also was involved with the Harvard Humanitarian Initiative and she is a UAV expert and particularly looking at the use of drones in a humanitarian context and she can speak to for example interactions with the Navy War College and their use of drones and their use, and their contribution to humanitarian missions. So, I'm afraid I cannot be more specific because I don't know - I wouldn't know the specific ways in which one side influences the other, but I am quite confident that it plays an important part. The civilian side in also informing the military side of potential use cases.

Q: Ok, I suppose I will ask one last question to round everything up. In the readings that I have been doing recently, in some aspects, drone technology or UAV technology, seems quite advanced, and in others its still in its infancy for example in transportation it seems still relatively - for example in the U.S. it is mostly in the testing period still... Now what is... Is this in your view correct? And what is the future of the humanitarian drone?

I would say in general as a technology it's all still in its infancy just to a different degree I think. I think as the rapid pace at which technology can be improved these days, I wouldn't be surprised

if two decades down the road, or three decades down the road, we would have a much more mature industry that has plateaued around, yeah, flying people around, with flying cargo around with drones, and having new sources of powering that. I mean, the future of, I think... more and more it will be used in humanitarian contexts because, as use cases increase, you know ten years ago you wouldn't have thought that there's these hundreds of uses, use cases for drones and as the use cases - and they will not grow indefinitely, at some point they will plateau and they may already have plateaued, I mean they have based on the current capabilities we have today. But I think they will be a fixed feature in humanitarian crisis and it will just be sort of incremental improvements where ok you may be able to add competencies and some capabilities... At some point.

Q: Great, here I just before we end I would like to give you space to make any comments or you know say anything that you would like to before I shut off the recording and in case there's anything that I have missed or you know that you have thought of that you would like to share.

Not that I can think of, but like I said I think you should definitely try to interview [redacted].

7.4. Appendix 4: Co-Founder and Executive Officer of an NGO.

Company type, location, and activities:

Right on, so let me check, what type of org and where, right? Our partners make use of drones for mapping purposes, cargo purposes and also release as another use and I can explain that a bit more if need be. We are not-for-profit organisation and we currently work in 29 different countries across Africa, Asia and Latin America through the Flying Labs network.

What proportion, would you say, of the industry is for profit and non-profit?

Our industry?

Well the UAV industry, particularly the civilian applications.

I think we see a combination of both in terms of actors, in terms of for-profit and not-for-profit.

My research particularly focuses on humanitarian drones, and within that it's specific to the applications surrounding health and public health. So what I would like to ask you is; what is your vision of the future for humanitarian drones, particularly in public health?

That's a great question. For me it's less to do about the technology and more to do about who gets to have access and benefit from these technologies, who is in position of leadership in applying these technologies in meaningful ways across the public space and last thing I would add is I would hope to see more focus moving forward on the most rural hard-to-reach communities rather than – well not rather, in addition to the focus, the current focus on large concentrated populations.

Could you develop the motivations behind this?

Yes, absolutely, and they're also based on a number of hypotheses but I think what we are seeing is – and it's not a criticism but rather an observation that the approach is incomplete but with the main players in the cargo drone space right now there seems to be a focus on serving the what we call 'high value routes', those routes that require high frequency high volume of deliveries. There were some studies a few years ago that suggested that to break even these companies would need to do 3000 deliveries per year, and we're seeing obviously Zipline is the leader in the

poll position in the space doing that many in a week, and so it seems like that is part of the revenue strategy for the big players. As a result then these big players aren't going to set up operations in a particular location where they're going to do 300 flights per year, not per day. And so what happens then? These locations that are more rural, more dispersed, smaller pockets of communities simply do not get to benefit from that particular type of technology and access to public health, and that's something that I'm, that's what I'm passionate about and I think to get in to that space will require either an update on the existing business model or a completely different but complementary business model to enable this to happen, because I've have conversations with these big players and they completely acknowledge that there's no way in heck that they're going to invest in setting up a fulfilment center or a drone port, whatever you want to call them, in an area that has very little demand, relatively speaking, but they also acknowledge that in many contexts those harder-to-reach more dispersed smaller communities face higher public health risks. So I would like to see that become a lot more uniform in that access to the services than is currently the case. Again, that is not a criticism in the sense that it leaves these big players – like who are we kidding there's only one – the big player here is Zipline, with what they're doing in Ghana and Rwanda – again I don't know how to independently audit or review this but they do claim to be able to reach up to 80-90% of the population if need be, I'm interested in that 10%, the folks that gets overlooked because the business models simply do not conform to what these companies need for those locations.

And, just for clarification, what would you see as the benefits of integrating those marginalised and overlooked populations?

I mean, it's duty of care, it's being able to ensure that everyone has access to the public health needs – public health services that they need for 10% of the population when we're talking about a population of 90 million is seriously problematic so for me it's a humanitarian imperative cause every individual deserves basic services including public health. So there's a value judgement, there's an ethical argument to be made there and then if you really wanted to go into looking for a health systems level argument you could also say well if outbreaks happen in those areas which are simply not being served, then obviously these outbreaks could spill over to larger populations and creating more of an impact. But even for me if that wasn't the case, I don't think

that's a leading argument at all, for me it's a question of actual equity and equal access, opportunity, inclusion and so on, especially for what in many cases are the most altruist vulnerable communities.

And would you say this is what your current work is framed by, is motivated by?

Yes absolutely, but this doesn't mean that Flyinglabs are restricted to that particular interest of ours now, it's not an either or, if FlyingLabs were interested in getting involved in higher frequency higher value routes we would obviously continue to support them, in no way would that be different, with everything we've got, with full 100% commitment, you know, so for example in Tanzania the Tanzanian FlyingLabs team is looking at a high-value route which I strongly encourage from a sustainability perspective saying 'you know what if you get that high-value route set up that potentially gives you enough revenue in order to subsidise whatever research, for some based on their mandate, you know, lower value routes, so you know again it's not an either or, it would have to be, it has to be complementary. I think the reason we are seeing Flyinglabs gravitate towards the harder-to-reach communities is in part because of their own values and priorities as they see it, and also I think because when you start talking about higher-frequency deliveries you talk about more sophisticated and therefore also more expensive cargo drone technology with higher overheads, higher maintenance costs, higher training costs, , higher insurance costs, and possibly requiring possibly more regulatory approvals which adds another cost so perhaps for those contexts and use-cases the private sector is perhaps best positioned to tackle those higher value routes. So that's potentially why right now, for the most part, for 95% of the conversations at Flyinglabs initiate with us – dealing with more dispersed hard-to-reach communities.

You touched on this in your very first statement, you made a comment about who should own drones. Could you develop a little more on this?

Yeah, I think, - I don't want to suggest that any of this it's an either or, I really think it depends on the local context, the local partners, clients, priorities, the budget, you name it right, but it's rather than saying that I'm anti-foreign ownership the way to put it rather is I'm pro local

ownership. And the reason for that is because ultimately, that creates less dependency, if these platforms can be locally owned you're creating less dependency on foreign actors, especially as some of these foreign companies are also looking at leasing models that never really allows for a complete ownership they always already have a level of ownership over the end users and while I understand the business arguments from these companies to do that I feel that that's, from where I'm sitting, having these companies be both technology providers and service providers that limits the ability, as far as my own opinion, of localised professionals having real full control over the services that they then offer. So, in an ideal world, and again I realise that not every country on the planet if we make analogies make their own cars, that I get, I think we are in a very different situation than manufacturing cars here, but I think in an ideal world drones are made in-country or within the region, so if they're not made in Senegal then at least they're made within the region of West Africa like Ghana, and transferred that way rather than having transfers from Germany, Australia, the US, and so on, we really become dependent on that company surviving which is not a given at all in the drone space, the cemetery of the drone space is larger than the current number of companies managing so far, so I think that's really really important. If I take the statistics from on top of my head, if I remember correctly, but definitely double-check, you know thanks to Zipline network, and I'm using thanks deliberately since it's really amazing, in Rwanda I think 70% or 80% of the blood that's transported across Rwanda is done by Zipline, so the entire country's blood supply, or at least a vast majority, something like 80% of the country's blood supply is dependent on one company that is a foreign Silicon Valley based company. That level of dependency is huge for something that is literally lifesaving and so what does that do that means that the company itself Zipline has tremendous power, power for good but also power to influence and ... - they have leverage. Again it is not a criticism because thank God that this is saving lives and so on, it's just unpacking it a bit and being aware of all the ins and outs of all this. So instead if this was a Rwandan company with the drones made in Rwanda you don't have that foreign dependency on a foreign company so, but that's in an ideal world.

So, you've already touched on the dependencies of a community to a foreign industry, and foreign market, and possibly the government? Would you say the Rwandan government on

this foreign Silicon Valley based company? Would that be fair, the two dependencies that you've addressed?

Well obviously, the government can be an enabler as well as a barrier, there's no doubt about that, right now at least in Rwanda, in Ghana, even though in Ghana there was a lot of controversy over the Zipline contract, it wouldn't have happened without Kagame in Rwanda, right, he basically he's a beneficial dictator and what he says goes so that created a space for Zipline to actually field test their platforms and so on, but yeah, the government is in the central component of this, with aviation regulations and so on, so without that approval of course it couldn't happen.

How do you see state ownership of drones, where are the dependencies there and are there certain problematic issues linked to this?

State ownership? I think where we see this, in Ethiopia but I have to check again where they are right now, it was a government sponsored initiative to sponsor making drones locally... I don't have enough examples to really understand from that or to show what the tradeoffs might be, so I'm not sure if I can comment as much on that.

That's perfectly fine. Would you say lobbying exists in the UAV industry and governments, and/or NGOs? What forms does it take? [interviewee laughs] Obviously we don't need to name any specific companies, we are talking in broad strokes about existence and what shapes it takes.

Right, ehmm lemme see, and if any of this doesn't answer the question but uh – there is a huge amount of lobbying, there is a huge amount of hype and nonsense to be honest. A lot of doublespeak, a lot of misrepresentation, just frankly false advertising on the part of drone companies – and not all, I realise I'm generalising, which is a dangerous thing, but I have witnessed enough of this first hand to frankly be quite disgusted by it, I think a lot of these drone companies are from the West and I often refer to them as drone cowboys, very arrogant, very self-centred, and they bring those sorts of attitudes to the relationships and partnerships that they

have and I don't have any patience for it. Equally problematic is how these companies and start-ups are getting huge support from their own governments and their own developmental organisations right, so GIZ and the German government is providing not just financial, but also strategic support to a number of drone companies coming out of Germany and connecting them with opportunities in developing countries which they otherwise would not have access to, and the same is true in the US with USAID, the same is true with Defid in the UK, Defad in Australia, and so it becomes a kind of mafia, kind of a consortium, a very small club of, an old boy's club, where all these special interests come together to form a dynamic whereby everybody who is outside that particular club is excluded so when you have other drone companies from other countries like Ghana, or Cameroon, or India, they're in no way able to compete, they're far more local and far more understanding of the local needs, the local contexts, than any foreign company will, they are shut out, they're completely shut out, and I think this exacerbates the Digital Divide, it exacerbates the inequality, it creates very clear winners and losers from the so-called 4th Industrial revolution, and structurally makes everything worse. If these development organisations, like Defid, USAID, GIZ, DEFAD and so on, we actually committed to equity, equal opportunity, long term development, and frankly dignity, they would be supporting local and regional drone industries, even if they are nascent industries, they would be pouring money to local drone start-ups, which again goes back to the previous question of not creating dependency on foreign actors, but they're not, it's just a very circular type economy where DEFAD will say well you know, 'we committed X million Australian dollars to development' and you find out that 80% of that goes to Australian drone companies to fly 2000km across the world and implement a project so, that's not a comment that is limited or exclusive to the drone industry, this is true about the development enterprise and the humanitarian industry as a whole, and that's why we see in the past 3-4 months a resurgence in discussions around anti-racism, and colonialism being alive and well in the humanitarian and development industries, that's all part of that – again, nothing that is exclusive to the drone industry.

Could you develop a bit more on the recent discussions about imperial... colonialism and the role of humanitarianism within this?

I mean there's a lot more out there than I could possibly cover right now but you know the humanitarian industry from day 1 has been about white saviours right, about the big humanitarian international organisations being headquartered in the Global North, largely funded by the Global North, and then you parachute in the foreign experts to go help around the world without realising that there is a significant amount of capacity, intelligence, ingenuity, resilience, and capacity already locally, but this top-down techno-centric foreign led approach to the humanitarian industry that we have seen for decades and decades is well entrenched in power bases, it's who actually has control and who decides, who has control of the money, the funding, and that's how the power dynamics evolve. And so if you're on the recipient side you don't have agency, you need help, it's just – there's just a lot out there if you Google just colonialism or humanitarian history, anti-racism, humanitarian history, there have been a number of phenomenal webinars recorded and shared publicly over the past few months that really unpack just how much of colonial ideologies pervade the humanitarian industry and the one I shared with you about Western organisation development funding Western companies to do projects in the Global South is just another example of that. It doesn't have to be that way but that's how the – that kind of, those entrenched interests and power imbalances operate so what we're trying to do in our own small way is actually be vocal about this, be vocal about the fact these dynamics absolutely exist, vocal about how racism, discrimination, and so on affect local experts who have expertise in the drone space and can actually implement these projects themselves without having to get, I don't know, a British drone company to fly halfway across the world to implement this project, we're trying to change this mindset, and a lot of it is mindset, it's very entrenched, implicit biases that come out of this whole system which has been founded on a colonial history, so you know that is a whole other topic but it is very much related to what we do at WeRobotics and why we do what we do with those FlyingLabs, it's to really demonstrate that existing capacity does exist for a large part in-country, that technology does exist, and frankly if the technology doesn't exist in-country yet and if certain skills and expertise don't exist in-country yet then the answer is not to parachute in the white experts from the outside, the answer is train those local experts to pick up these additional skills, have access to these additional technologies, so that they can go ahead and implement those projects for public health services to remote communities, but that's just not how the political economy of the humanitarian industry operates. I could go on and on about this topic.

The drone has been marketed as a revolutionary or turning point technology. Could you say either why, or why this language is present in the discussion of drones?

Why it's considered revolutionary and so on?

Yes, specifically these kinds of words, revolutionary, pioneering, innovative, these words come up pretty much every time you read a media piece about drones. Why do you think this sort of language has come up and what do you think it does for the discussion of drones?

I think some have clear interests in hyping things up, and if you are the technology provider you want to describe your technology as revolutionary, right? Regardless of if it is or it isn't, regardless of whether you are actually able to demonstrate positive social impact you're gonna jump in the bandwagon, you know it's the same thing with Blockchain and Deep learning and all that stuff, but, I am sure I have been guilty of using that language too. I don't think we need to call it revolutionary to be impactful, I think what's exciting is that, you know, this technology does allow you to do things you weren't able to do before. I don't know if that's the definition of revolutionary, I don't, again, think that language is necessary, but for us yeah the excitement is that, you know, this is, this technology, it's an example of an early shift, we're still at the very beginning of this, it's an early shift from manually controlled to increasingly intelligent and autonomous, putting quotes around that, system, because drone technology is not quite there yet, but it's that first step, it's going from, you know we're at the, we're at the last version of the Nokia phone from the late 1990s, early 2000s, before we make that jump to the smartphone, right? I think that's where we are in the drone industry right now, that we are, it's a hypothesis, I expect that we will start to see robotics, mobile robotics solutions, not just the flying ones but the driving ones and the swimming ones, get closer to this other end of the spectrum towards autonomous intelligent systems but even though we're not there yet what this technology allows us to do already is increase efficiencies in rather, you know, radical ways, and so what's exciting about that is can we therefore bring some of those gains in productivity and efficiencies to the social good space in a way that is ethical, responsible, empowering of local experts and

obviously impactful. So that's what's exciting for us. Whether it's revolutionary or not I'll let other people decide if so and why and so on.

Following on from this, would you say that UAVs are increasingly present in society? What factors do you think are behind this? If yes, then where are they increasingly present and what kind of timeframe do you think is appropriate for this increasing integration?

I don't have the latest data points on this, but I mean we are seeing this has become a multibillion dollar industry and I think this is in large part due to one company, DJI, which has been able to go beyond just the industrial space, beyond industrial drones to consumer drones, which you know really socialised the technology and captured people's imaginations and rightly so, and in capture our world from a completely different perspective, whether it's photography, or humanitarian applications, so we've gotten to a point where obviously the industry figured it out, or at least some did, and have been able to reach a price point and a level of reliability that, and user friendliness, which helps to quote on quote democratise the technology so that you no longer have to spend 80 thousand dollars to capture some aerial footage, you have a Mavic drones, for older versions or secondhand for a few hundred dollars, which still gives you almost a whole new level of quality in terms of resolution of the video and the photography and the design and so on, so I think, it's obviously not as pervasive as smartphones by any means but it's entered the consumer space and I think that's where things really take off. You see a lot of innovation happen there. I imagine this will continue to grow as an industry and that's what the forecasts suggest you know, so we shall see. I think the situation with COVID and the need for contactless technology and so on, that's been an advantage for some in the drone industry as well. So I think it's accelerated that shift for some companies as well. Does that answer the question or...?

Yes, that's perfectly good, thank you. You mentioned COVID which nicely moves us along to another question, which is what effects do you see of the pandemic on the usage of UAVs, and particularly looking towards the future? So not just how they're being used now, but how do you think this will possibly facilitate future uses and integration of this technology?

That's another great question. I think what we've seen is that the impact of COVID has – I don't know how bold I should be – but clearly demonstrated the added-value of drone technology in a far more maybe forceful way, in a very short period of time. I think we would have gotten there, but it wouldn't have been months it would have been years. I think publics, I think governments have fast-tracked a lot of decisions around drones, drone regulations, drone operations due to COVID and we see that demonstrated in how some governments have fast-tracked certain new pieces of legislature on drones set up, even if they are temporary measures, regulatory measures around drones they've gone ahead and done that and I think that now, we've definitely passed a milestone there, politically, from a regulatory perspective as well, so that's a plus. I think most will benefit from government realising now that this is not just a fad, or something that's going to come and go, but this is very much the future. It's not all positive but at the same time because, and again this is – I have to be very clear this goes beyond my area of expertise and knowledge, so I am just speculating and this is hypothetical, but I imagine that we're seeing a number of drone companies, and not only drone companies but companies in the drone industry so including software companies, start to struggle right now because of COVID and the impact and the global recession, impacts on clients and so on, and so we may actually see that graveyard, the cemetery of companies in the drone industry have actually grown, especially maybe the smaller ones, the ones which haven't spread their risks around and are dependent on one or two key players, key actors or key donors, who are now being hit hard, it's going to be interesting to see how if and how they're able to weather this storm, just from a survival perspective, and what that means is indeed if the small companies and smaller players go out of business then there's more power that is consolidated within the bigger actors, so we may see a consolidation of power there, which is usually not a good thing, reduces choices, reduces competition, increases dependencies, and so on, so we'll see how those to be specific in terms of your core area right, with public health and transport of cargo, you know besides Zipline and Matternet you know how are the other much smaller players going to weather the storm... the Wingcopters, the Swoops, and even smaller ones who cannot actually – who have engineers either they have to lay off or find a way to pay, but they're not getting any revenue because none of their platforms are flying for those smaller companies so what does that mean? Does that mean, you know, we get out at the end of this pandemic in a year or two with just two drone

companies both from Silicon Valley and that's it, you know, so that's it, it's speculative, I don't follow the industry as closely as I probably should.

You talked about a consolidation in the market. How would a legitimization of civilian, social, and humanitarian applications of drones affect state use in the military and security fields? Would you say there is a relationship between these two spheres of the civilian and the military?

That's a great question, and my colleague [redacted], that's a subject she's spent years looking into, and from what I've read [audio crack] and what – from what she's confirmed, the civilian drone industry, from the DJIs to the Senseflys to the Parrots, none of that came out of military research, in fact it's very different technology than the heavy, large, long-range military drones that have been used over the past decades. So, they're actually quite distinct from an engineering perspective and from a source perspective. A lot of individuals, organisations, policymakers, government officials have blurred, either intentionally or mistakenly, the lines, insinuating, or outright stating that 'oh, all these drones being used in civilian contexts are military drones', which is complete nonsense, they're not military grade systems. Now, what we are seeing related to this general topic though is the use of these small civilian consumer drones, some industrial drones, for military purposes, so it's kinda gone the reverse side, right? So you have this civilian drone industry that has sprung up independently of the military drone industry, that is now being leveraged by the military and by non-state armed groups, militia groups, terrorists, and so on, there's plenty of evidence for that in Syria and other places as well, so – but I would keep them somewhat distinct although of course there is that relationship because you could certainly use as well, and you know the examples I've been talking about with respect to Syria are more using drones, consumer drones, industrial drones, for cargo, basically bombing. And we've also seen examples of consumer industrial drones being used for spying and intelligence gathering and so on, I don't think anywhere at the level of what military drones are capable of and I think what's been quite telling as well in a context of the US over the past several months is how widely used the military drones have been for surveillance against the protests, the protesters, with the Black Lives Matter movement and so on, but also manned aircraft, there have been a number of these plane spottings throughout the US and elsewhere and they've uncovered an extensive network of

small Cessna type planes and being used by the intelligence community and law enforcement, you know, in response to the protests and so on, so again I think the use of these industrial, commercial, civilian drones for military purposes really pales in comparison to the military drone community which have been developed for that purpose. It doesn't mean it's non-existent though, I just want to acknowledge, yeah, there are plenty of examples, but we're talking about maybe one drone – for every one hour a civilian drone is being used for military purposes we're seeing ten thousand hours of military drones being used for military purposes, for intelligence purposes. That's truly speculative of my side, I don't have data to back up my claim, I want to put that out there, but it's where I would put my money.

So that's actually the more concrete, literal shall we say transfer of technology from each side, but if we look more at a legitimation side, more of a social acceptance side, if say – well, take the example of Zipline; in one article I read, once the novelty wore off of having these payload carrying drones delivering blood, once the novelty was gone, it taken completely as routine and it felt almost necessary and warranted to have these technologies in place. Do you expect a kind of acceptance of wider application as more and more technology is accepted, so as we see the drones coming into the civilian world, can we see maybe a speeding up of the process, or such a phenomenon?

That's a very good question. Yeah, sorry I do think this is – you know, this is going to become widely accepted and nobody is going to think twice about it in a couple decades, if not less, so from a social perspective, society perspective, absolutely, and I remember twenty years ago, it was during the height of the Cold War, and in the decades after the Cold War, and even up to well basically until 2005 when Google Earth was launched, satellite imagery had one and one only application; it was military, ex-Soviet Union, spying, Cold War, military, intelligence, clandestine operations and so on, that was is right and then 2005 comes along and gets launched, democratizes access to satellite imagery in a way that's never been seen before in human history and it's now 2020 and if you start asking a digital native about satellite imagery, so then it's about 'oh yeah my house on google earth', google maps, directions to the nearest Starbucks, or whatever it is, the first connotation is no longer military and I think the idea is a good and bad analogy maybe, so with drones and drone deliveries it's just not gonna – it's gonna be self-

evident, it's gonna be obvious, you know there's a great book a little dated but still worth a read, by Clay Shirky, probably a good 12 years ago, I forget the title of it though, but it's still from 12 years ago, one point that he says in the book is, you know, 'technology – the moment technology is really had their most profound impact on society is when they're considered boring, when an emerging technology and a new technology, and a frontier technology and all that hype gets to a point where it's boring and routine, that's when you have that systems-wide impact that happens, and I think we're gonna look back and think you know, if we'd had a choice, you know, 20 years ago, yeah, but yeah, I'm going on a tangent, but what I'm trying to say is it's going to be as obvious as 'oh would you rather take a horse to get to Paris tomorrow or do you actually want to get on a train?' right, why would you take the horse, why would you do it manually, as opposed to using autonomous solutions that save time, costs and potentially hopefully safer in the long run anyway, so I think it's going to be plainly obvious, and just no longer questioned, but you know I might be proven completely wrong, we'll have to see, there is obviously a backlash, there's going to be more backlash especially I think, not so much with aerial drones but with autonomous driving vehicles if we ever really get there, I guess we will but a lot of people are rethinking their timelines for that, but if you – just as quick example to tell you the future is not necessarily all rosy in this particular context, but in the US significant number of jobs are held by middle income lower income workers who work as truck drivers, right, in criss crossing the US to deliver goods, it's a job that does not require a university degree, and becomes a really important source of livelihoods for a significant number of Americans in lower income, middle income states. If that gets replaced by these autonomous self-driving lorries and so on, you know it'll be a huge, huge social impact on unemployment and so on, it's going to be absolutely massive, so there it no longer becomes a question about technology, and whether I think it's potentially inevitable, but I think we've seen from countries especially in Europe and Scandinavia there's a strong role for government here to help manage these kinds of shifts and ensure that individuals have – are gainfully employed, and have dignity and so on, so anyways, maybe a bit of a tangent, but there's some serious policy, government interventions that are gonna be required to ensure that this doesn't happen, further exacerbating the extreme inequality that already exists in society, so, anyway, that's my two cents on that.

Please don't worry about tangents, the whole point of this kind of interview is to have tangents, so there is no linear answers, it's very much about you talking about your thoughts and perceptions. Because I'm conscious of the time and I know you are quite busy, I will move us on to the last couple questions, they are interlinked so it should flow fairly well. You started talking there about potential risks with UAVs. What are the influences to the perceptions of these risks?

What influences our perceptions of the risks associated with drone technology? That's a great question too. Well I think, maybe a couple years ago, maybe to bring it back to robotics and autonomous systems, I know a few folks who work in the robotics space and really from a social impact perspective, at least a couple years ago, we're really just frustrated by movies, and how movies portray - and shows and television series, portray drones going haywire, you know the whole Terminator kinda science fiction thread that is alive and well, and for them they're saying this really just creates perception amongst the broader population, you know we are, we're being careless and unethical and all that stuff, you know, and to their credit at least the folks, some of the folks that I've been in touch with, you know, are ethics and possibility are very much front and center to everything that they do so I think that just with movies and tv series and science fiction, you know, it just it helps to create a perception that is maybe quite removed from reality, but does have an impact on their work and their funding and what they can do. I think the same is, I mean I cringe when I just happen to watch a TV series and there's your token drone and either the drone starts shooting people - you know just a regular consumer drone - or something else goes haywire and it just paints the drones in a very negative way so I think what you do see in the entertainment industry, what you see in the news industry as well, for the most part this is improved, but it has improved marginally, so I want to acknowledge that. It doesn't usually make the news if it's a good story, and so in the entertainment industry, in the news industry it's motive is amplifying perceptions that are not always helpful and not always tied to reality either. Not suggesting that it's always wrong, but it probably doesn't help much, and then I think, the discussion that's been going on for decades and decades and decades around robotics and unemployment, and where you see seems... Interestingly, the debate academic or not, is not one sided, we're seeing plenty of studies saying 'no this would create more jobs, not fewer jobs', right but there's obviously fears there, driven again I would say by the news and entertainment

industry, and obviously entrenched interests, that I would say you know we should resist all this, it's going to limit jobs, so, anyway I think maybe that helps amplify the risks, anyways that's where I would go with that question.

What about such perceived risks as privacy? Privacy is something that you see come up quite often in relation to drones, regarding the data, regarding facial recognition, regarding the encryption of the communications between drones, and storage spaces. What do you make of such perceptions?

[laughs] extremely valid, and I'm sorry I didn't bring that up. One thing, they're absolutely instrumental, they're serious you know, absolutely very serious, and just to bring it back to WeRobotics, all our trainings include a component on community engagement, from the perspective of you know informed consent, as well as the privacy issues, the very real dangers around releasing personal, personally identifying information, as well as community identifiable information, geographically identifiable information, and all that so it's actually quite serious, they're not – I don't think they're over hyped at all, I actually maybe wish there was more attention in general brought to these issues. Now we've seen government kinda catch up and so on, which is a good thing, as well as humanitarian organisations, which is also a good thing, but yeah absolutely just like any other kind of technology that can collect data, you start having mass consumer type or industry technology that you start using smartphones as other examples right. I think that yes, those are serious and you know, and there are now more and more guidelines, protocols, dos and don'ts, best practices around these issues. Doesn't mean they're all resolved by any means, I think at the same time it's really really important to take a step back and look, compare the privacy issues around drones with those around smartphones, social media, and satellites because I think the same applies to what I said, one hour of civilian drones, to ten thousand military drones, you know for one gigabyte of a drone imagery that's collected there's terabytes of imagery gathered by satellites, and terabytes of data collected through smartphones, and social media as well, so it pales in comparison. It doesn't mean the privacy issues don't exist, it means that if we look at the whole world of technology and privacy issues, drones represent one percent of the data being collected and made public as far as I'm concerned, so we have to figure out our one percent, because that for us is one hundred percent of our world, in the

drone industry, so there's no doubt about that, and there's some serious negative repercussions and implications of using this technology if it's used for that, but if you take a few steps back we represent like one percent of the whole emerging technology space.

Would you say then, some of these issues are maybe being neglected in other areas and focused on in the drone sphere?

Yeah, absolutely, and I have to leave in the next minute because I have to get my son to school, but obviously social media is getting all the attention. Facebook is being hammered, and rightly so, that's a really good thing to do, and there seems to be advocacy around that. What I find fascinating is how much the satellite industry is getting away with it, it's just I mean again for every gigabyte they collect several terabytes a day, and yet, their resolutions are getting higher and higher, they're temporal resolutions are getting higher and higher and higher, and the amount of data that you can collect and identifying information that you can collect with satellite imagery is orders of magnitude higher than drones, and yet every time you talk about imagery, you know, and privacy, 95 percent of the time it feels like it's about drones, even though drones collect at most one percent of all remote sensing data, as compared to satellites. And yet, you know, we're not getting that kind of backlash which is probably fascinating, and then unacceptable as well. And by the way this is – if drones didn't exist – that comment isn't a drone comment. If drones didn't exist I would be frankly appalled by the lack of pushback and oversight by civil society against the satellite industry, I think it's mind blowing, it's just they're residing very comfortably off of the attention being given to the drone industry, you know. They are not the focus of attention, and that is completely misplaced and messed up. It should, it's anyway – I've got to run.

[end].

Last set of questions delivered by email because time ran out. Because interviewee was busy, answers were given back as bullet points.

What were the films/tv series that you were referring to when you said that drones are often represented as dangerous, etc? (any number of examples would be appreciated).

Honestly don't remember the specific titles.

As you discussed some of the perceived risk around drones, what are some of the things being done to assuage or counter them? What more could be done in the short & long-term? (for example, you spoke of the measures put in place in the training process for privacy related issues. With this question, please feel free to discuss anything you feel is most pressing & appropriate).

Training, awareness raising, government regulation.

Final question, you discussed the need to localise the operations of UAVs to communities to avoid dependencies; what are the pathways to this? The constraints and obstacles? How can it come to be (i.e. regulation, self-regulation by private companies, independent parties, so on....)?

Pathways to this are initiatives like the Flying Labs network.