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PROFESSIONAL DRONE USAGE IN SWITZERLAND : RESULTS OF A QUANTITATIVE SURVEY OF PUBLIC AND PRIVATE DRONE USERS

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Abstract

In recent years, drones have become much more accessible as professional tools for public and private actors. The technology has been integrated into everyday working routines and has created new professional fields. These developments have sparked increased media attention and socio-political debate regarding the opportunities and risks of drone use, and the necessary regulatory response. However, in Switzerland as elsewhere, no detailed study has explored who uses drones, when, where and for what reasons. Addressing this research lacuna, this paper summarizes the main findings of a quantitative survey of public and private drone users in Switzerland. On this basis, the paper highlights the extent, modalities and expected future evolutions of professional drone usage in the country and underscores the related key issues, in economic, privacy- and security-related terms. The paper thus informs citizens, public agencies and the private sector of the various dimensions and effects of current evolutions in the field of drone utilization, raises awareness of the advantages and problems of the technology and, ultimately, favours critical democratic debate.

Keywords

Drones

Airspace

Professional drone usage

Switzerland

Drone legislation

Acknowledgments

1. Introduction

In Switzerland, as elsewhere, drones have become increasingly important as professional tools across the public and private sector. The media and political debates have not only emphasized the various benefits related to the technology's rapid diffusion, including the emergence of novel professional fields and the improvement of existing working routines, but also focused on the risks and juridico-administrative challenges arising from the integration of professional drone usage in the Swiss airspace (Canal, 2014; RTS, 2014; Hardegger, 2017). These discussions convey a range of basic assumptions and opinions around the usage of drones that often lack a solid foundation, in that they largely ignore not only the extent, modalities and objectives of current drone usage, but also the ways in which drones are conceived, perceived and experienced by their users.

Addressing this lacuna in empirical detail, based on selected results of a quantitative survey amongst public and private drone users in Switzerland, the present paper is structured into four main parts. These respond to the following questions, after an initial methodological discussion:

    a) Who uses drones for professional reasons in Switzerland, how, where and why?
    b) What are the motors and obstacles, opportunities and risks of professional drone usage?
    c) How do professional drone users assess the existing Swiss drone legislation?
    d) What is the anticipated and desired future of professional drone usage in Switzerland?

2. Methodology

The paper presents select results of a fully anonymized, quantitative online survey, conducted (through Qualtrics) between July and September 2017. This section explains the design of the questionnaire, before outlining the adopted sampling strategy and the logics of distribution of the survey among professional drone users in the public and private sector.

2.1. Elaboration of the questionnaire

The present study of professional drone usage follows on from a previous public opinion poll, conducted in 2015, which explored the perception and acceptance of drones by the general public, highlighting societal demands and expectations with regard to the opportunities and risks of drones and the requested type of legislation (Klauser and Pedrozo, 2017).

The questionnaire used for the current survey is based on a systematic review of existing academic and non-academic literatures around the drone problematic. This has allowed the identification and ordering of the key issues and research gaps in the field (Klauser and Pedrozo, 2015).

The setting up of the present survey was informed by exchange with various key stakeholders in the field, including in particular the *Federal Office of Civil Aviation*, the *Swiss Federation of Civil Drones* and *UAW.aero* (see acknowledgements for more details). The resulting collaborations offered important inputs with regard to the key concerns and issues addressed in the questionnaire.

2.2. Structure and content of the questionnaire

The survey questionnaire covered the following eight main themes:

    a) Basic information about public and private drone usage in Switzerland (drone types, deployed software, frequency and height of flight, forms and places of usage)
    b) Reasons for the usage of drones
    c) Practices of professional drone usage

d) Collaborations in the setting up and usage of drones
e) Emerging questions with regard to the airspace within which drones operate
f) Advantages and disadvantages of drones
g) The legislation in the field
h) Future scenarios of drone use in Switzerland

In most cases, the same questions were asked to survey participants from both the public and private sector, with both groups being furthermore subdivided into five professional subcategories (see 2.3.). Importantly, the aim of the survey was to acquire responses not only from public and private organizations that already use drones, but also from those that do not yet have a drone but are interested in the technology's possibilities. Depending on whether or not they had a drone, participants took different paths through the questionnaire, with only some questions being identical for all categories, thus allowing wider analytical generalizations. For the sake of simplicity and consistency, the results presented in this paper mostly refer to the answers of survey participants that already use drones.

2.3. Survey distribution

To set up the address file for the distribution of the survey, the two initial categories of "public" and "private" drone users were each further subdivided into 5 categories. These subcategories were identified through the abovementioned literature review and consolidated within a series of exploratory interviews with drone professionals, drone associations and public institutions.

Private drone users	Public drone users
Aerial photography and cinematographic industry	Fire brigades
Security businesses	Police
Geometry and cartography services	Emergency services (without fire brigades)
Infrastructure services	Archaeological services
Agriculture	Urban planning services

Table 1: Professional categories used for the setting up of the address file for the survey

In total, the questionnaire was sent by email by the research team to 562 private companies and to 297 public institutions. Furthermore, aiming for an approach that allows contact with as many institutions and businesses as possible within the predefined professional subcategories, a range of holding associations and other potential distributors of the survey were identified and subsequently contacted with a request to diffuse the link to our online questionnaire amongst their member organizations by email. Thus in total, the web link to the survey was sent in a targeted way to 3,170 recipients. This number neither takes into account the possible further diffusion of the survey by recipients who might have contacted yet other institutions or companies, nor includes the wide-spread diffusion of the survey by newsletter, as done in particular by the Swiss Association of Engineers and Architects (dispersing the survey link amongst 15,000 recipients).

With Qualtrics allowing only one questionnaire to be filled in per IP address, each contact could in principle participate only once in the survey. The risk of participants filling in several questionnaires by using different computers (for example at work and at home) appears very small, given the limited stakes of the survey.

2.4. Survey participants

During the survey period of ten weeks, spanning from 5 July 2017 to 18 September 2017, 1,014 participants were registered, filling in a total of 922 valid questionnaires (either in French or German). This makes the present survey the first systematic and comprehensive

study of professional drone usage in Switzerland, providing a detailed picture of the phenomenon's extent, facets, related risks and opportunities and expected future evolutions.

Overall, 490 representatives of private companies and 432 representatives of public institutions filled in the survey (Figure 1).
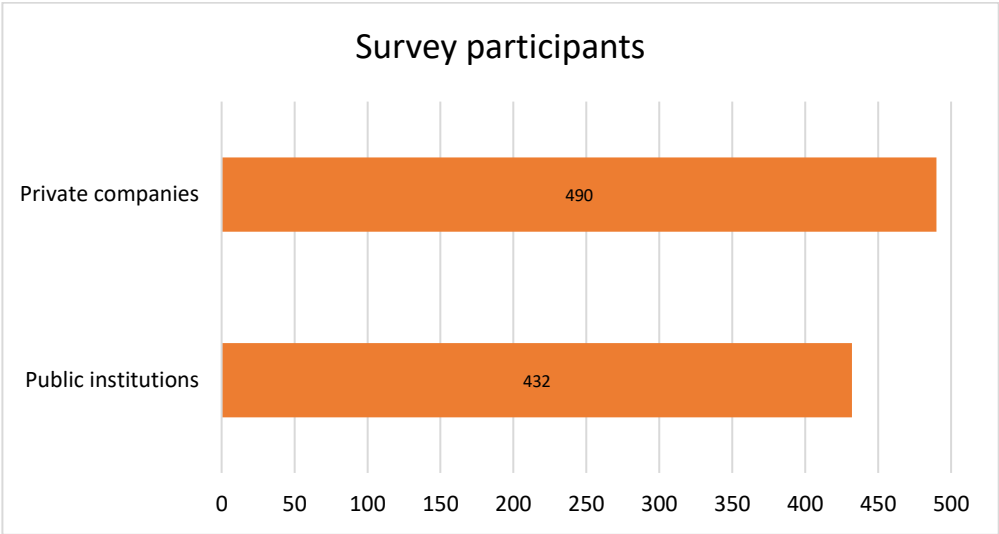
Survey participants

	Value
Private companies	490
Public institutions	432

Figure 1: Survey participants, N=490, 432

Most of the private companies that took part in the survey specialize in aerial photography (23%), land survey and cartography (20%) or the cinematographic industry (15%). Public participants were mostly from the police (41%), followed by fire brigades (11%) and spatial/urban planning institutions (11%). A third of both private and public categories is made up of "others", i.e. those participants who responded to our survey – received in this case mostly through the mailing lists of professional drone associations – without falling into the pre-selected professional categories. As suggested by the participants' own statements, this is the case in particular for architects and real-estate companies in the private sector, and for offices specializing in GIS and engineering in the public sector (Figures 2.1 & 2.2).

Areas of specialization of private survey participants	
Aerial photography	23%
Land survey/cartography	20%
Cinematographic industry	15%
Agriculture	5%
Security	4%
Infrastructure control	3%
Others	30%

Figure 2.1: Areas of specialization of private survey participants, N=425

Areas of specialization of public survey participants	
Police	41%
Fire brigades (with and without integrated emergency services)	11%
Spatial/urban planning	11%
Archaeology	5%
Emergency services (not linked to fire brigades)	1%
Others	31%

Figure 2.2: Areas of specialization of public survey participants, N=400

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71% of the private participants own a drone, compared to 25% of the respondents from the public sector (Figure 3).
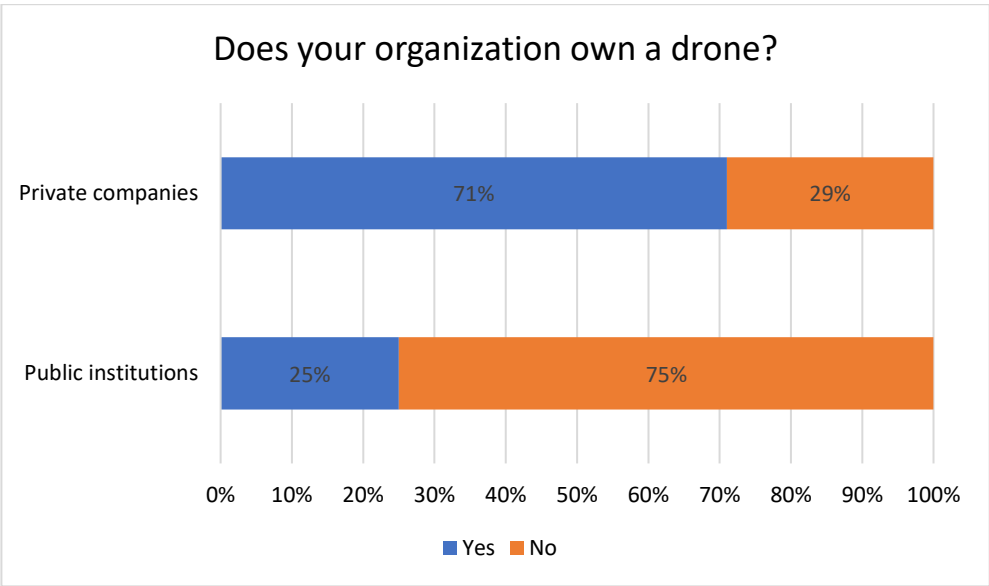
Does your organization own a drone?

Figure 3: Does your organization own a drone?, N=421, 383

Amongst the private participants without a drone, 43% have thought about purchasing one, whilst only 23% of the public actors without a drone responded likewise (Figure 4).
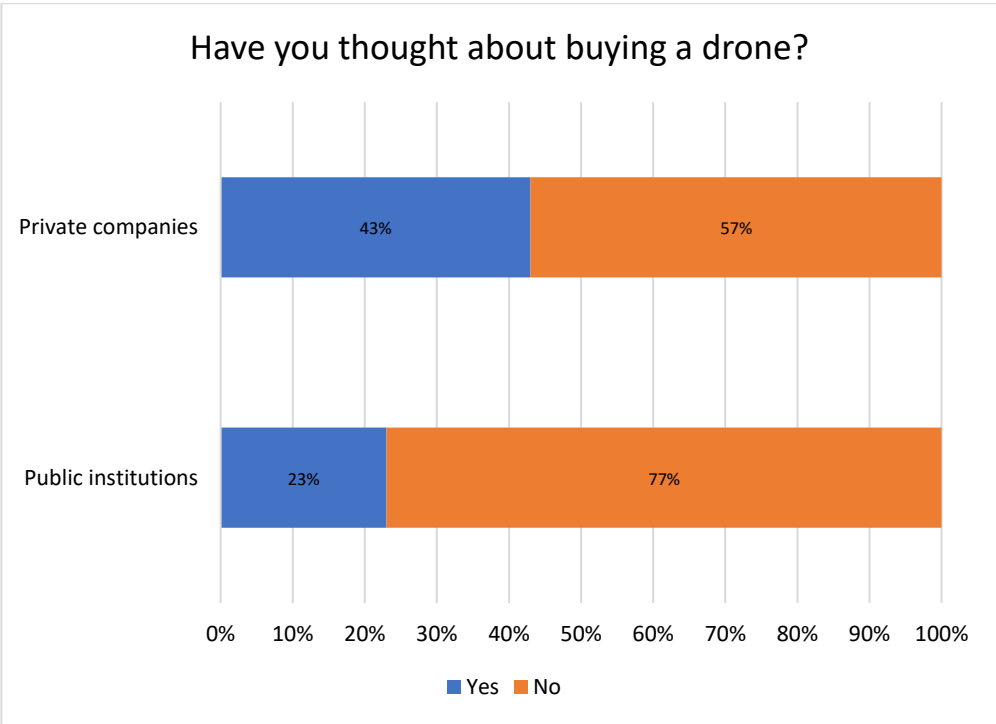
Have you thought about buying a drone?

Figure 4: Have you thought about buying a drone?, N=282, 66

3. Analysis

3.1. Who uses drones, why, where and how in Switzerland?

This section shows who uses drones in Switzerland, why, where and how. Provided insights can be structured into eight main aspects.

a) *Drone users* (Figures 5.1 & 5.2): 299 respondents from the private sector ("private participants") and 94 respondents from the public sector ("public participants") confirmed to own a drone. Note that this does not provide a solid number of how many private and public organizations in Switzerland use drones, because (1) not all companies or public institutions might have participated in the survey, and/or (2) because several people from the same organization may have responded.

Amongst the survey participants from private companies who use drones, we find 28% that specialize in aerial photography and 23% working in the fields of land survey and cartography. In turn, amongst the participants from public institutions with drones, 50% are from the police and 10% work in fire brigades.

Areas of specialization of private participants with drone	
Aerial photography	28%
Land survey/cartography	23%
Cinematographic industry	16%
Infrastructure control	4%
Agriculture	4%
Security	1%
Others	25%

Figure 5.1: Areas of specialization of private participants with drone, N=299

Areas of specialization of public participants with drone	
Police	50%
Fire brigades (with and without integrated emergency services)	10%
Archaeology	8%
Spatial/urban planning	4%
Emergency services (not linked to fire brigades)	1%
Others	27%

Figure 5.2: Areas of specialization of public participants with drone, N=94

b) *Frequency* (Figure 6): Private drone users deploy the technology more frequently than public drone users. 38% of the companies with a drone use their drone at least once a week, compared to 14% of the public sector. 5% of the private drone users and 3% of the public drone users operate drones every day. This suggests that a growing number of private businesses is now structured around the usage of drones, whereas the technology is used in more sporadic and auxiliary ways by public institutions.
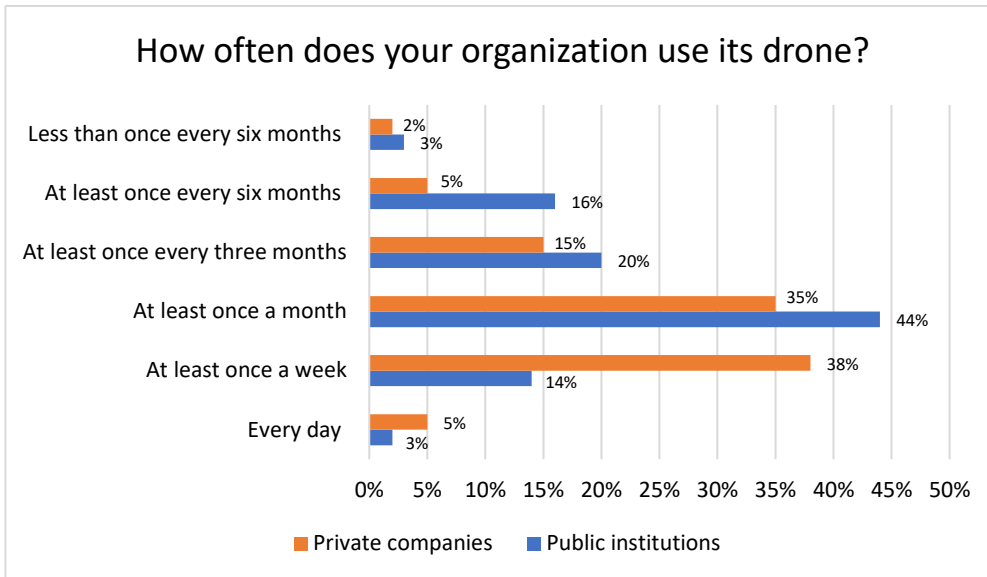
Figure 6: How often does your organization use its drone?, N=281, 79

c) Past evolution (Figures 7.1 & 7.2): Drone usage has developed very recently. Only 6% of the private drone users and 11% of the public drone users started using drones before 2010. This reiterates the recent proliferation of professional drone usage, and hints at the likely future evolution in the field.
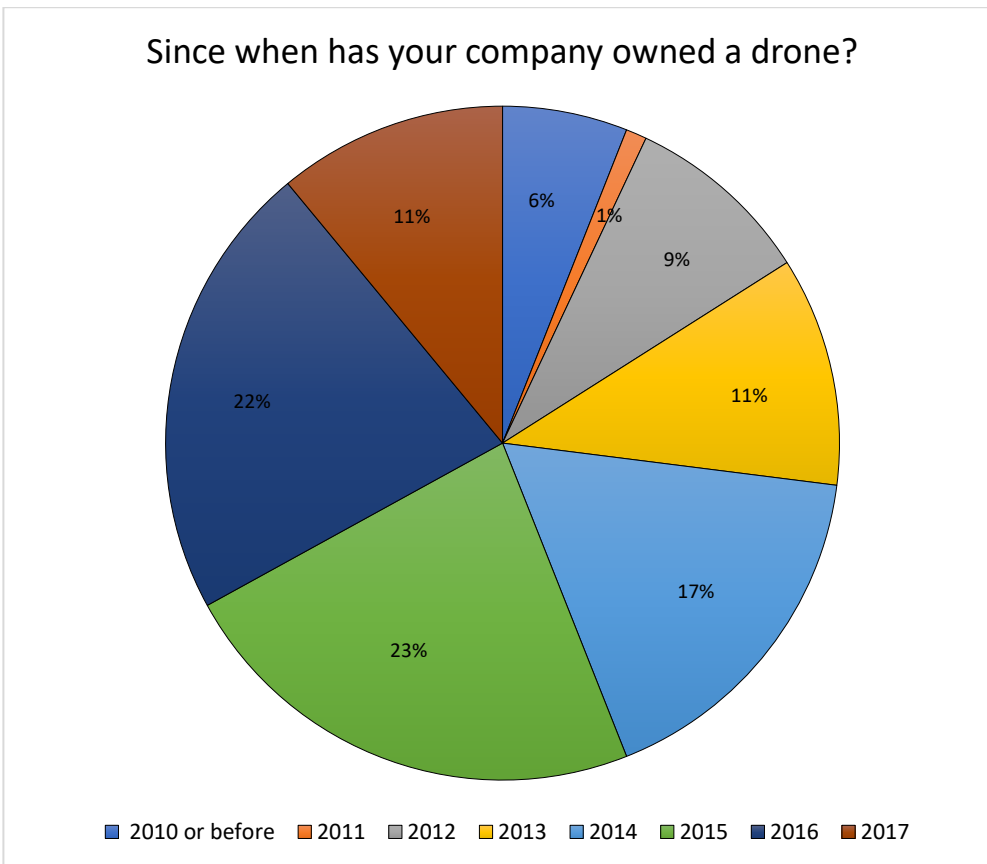

Figure 7.1: Since when has your company owned a drone?, N=287

Since when has your institution owned a drone?
(public institutions)

11% 9% 11% 13% 24% 21% 11%

■ 2010 or before ■ 2011 ■ 2012 ■ 2013 ■ 2014 ■ 2015 ■ 2016 ■ 2017
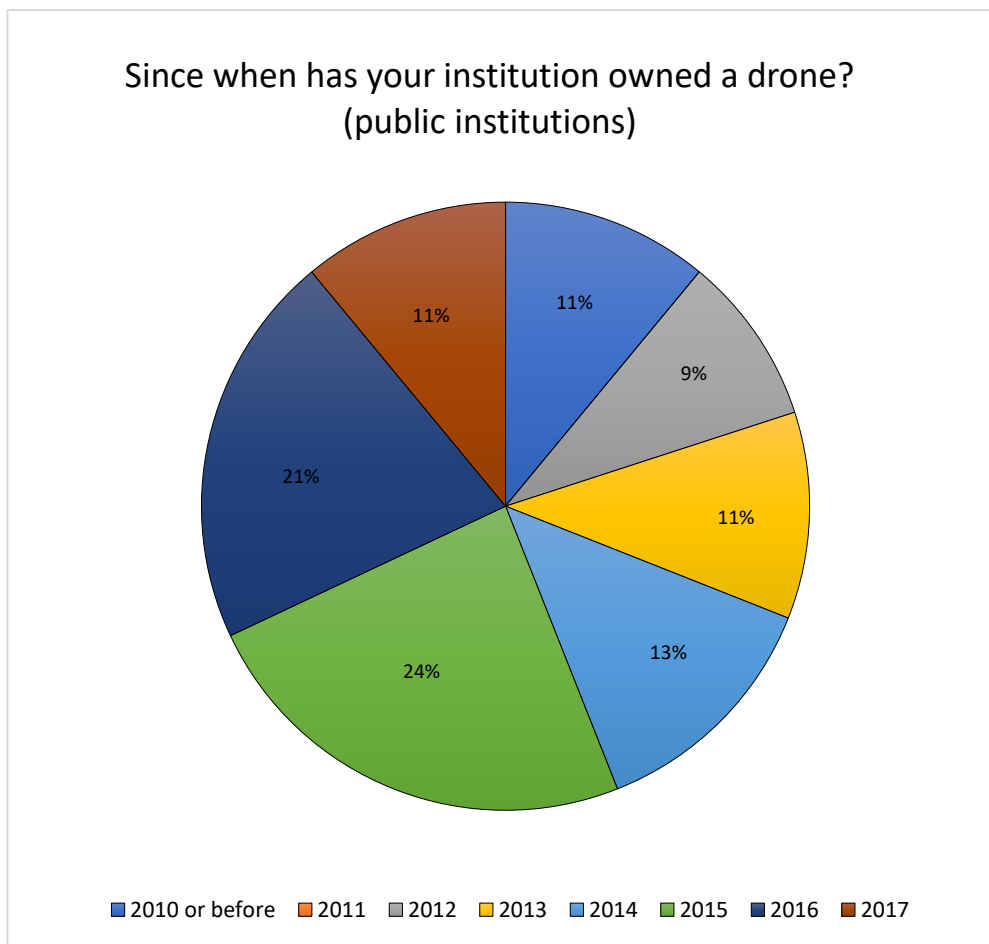
Figure 7.2: Since when has your institution owned a drone? (public institutions), N=85

d) Sensors (Figure 8): Most respondents use drones that are equipped with photo cameras (40% of the private participants; 46% of the public participants) or with live stream video cameras (32% of the private participants; 30% of the public participants). Only a limited number of participants use infrared or thermic cameras. With the exception of one survey participant, all drones are equipped with at least one type of (visual) sensor. Drones are thus very unlikely to be used for transportation purposes alone.

Type of sensor	Private companies	Public institutions
Photo camera	40%	46%
Video camera with live stream	32%	30%
Video camera without live stream	10%	7%
Thermal camera	9%	8%
Infrared camera	4%	5%
Air quality measuring device	1%	1%
Laser sensor	2%	0%
No sensor	0%	0%

Figure 8: What sensors do you use with your drone? N=529, 123 (several responses possible)

e) Software (Figure 9): 35% of the private drone users and 50% of the public drone users work with image-analysis software. From this perspective, and speaking in relative terms, public drone usage is technologically more advanced than private drone usage.
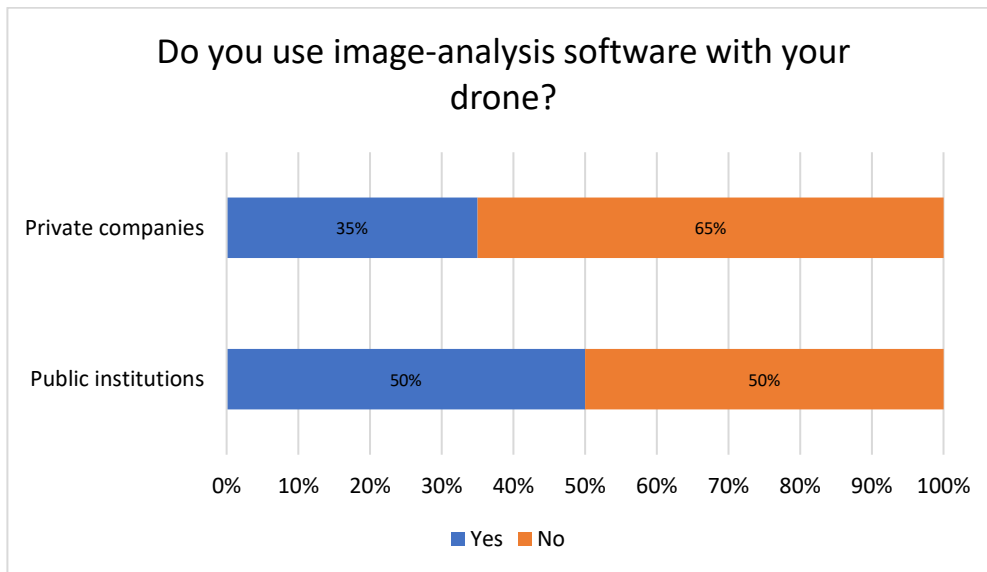
Figure 9: Do you use image-analysis software with your drone (e.g. photogrammetry, facial recognition, automatic surface evaluation, etc.)? N=275, 68

f) Types of drone usage (Figures 10.1 & 10.2): Amongst both private and public drone users, drones are deployed most frequently for purposes of aerial photography (21% of private participants; 24% of public participants) and for cartographical and land-survey missions (19% of private participants; 23% of public participants). Aerial movie making is much more frequent with private than with public drone users (24%, against 3%), whereas both user categories deploy drones for purposes of surveillance and planned observation (17% of private participants; 13% of public participants). Thus if drones are used as aero-visual techniques by both private and public actors, the purposes for doing so coincide in the case of aerial photography, but not necessarily in that of aerial filming.
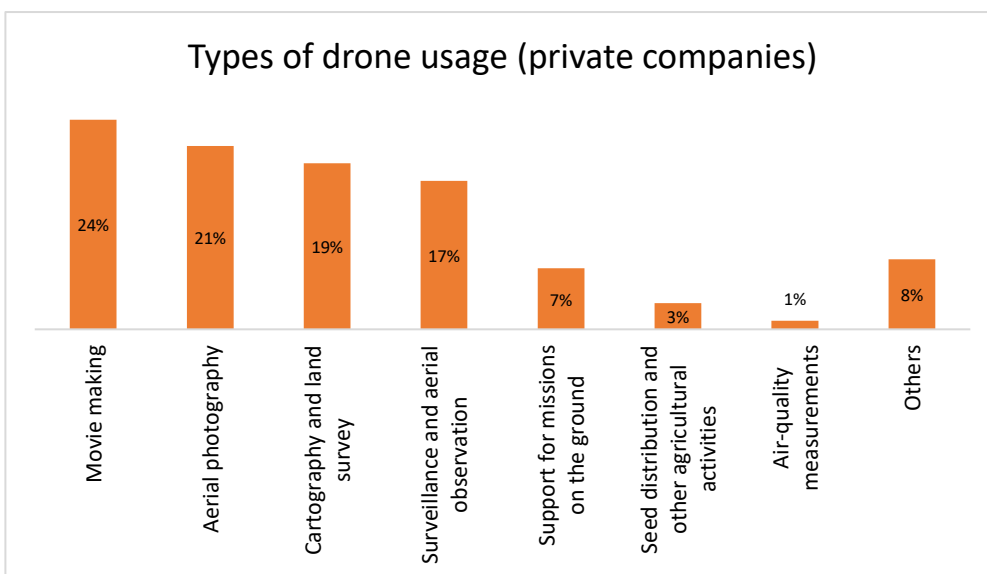
Figure 10.1: Types of drone usage (private companies), N=487
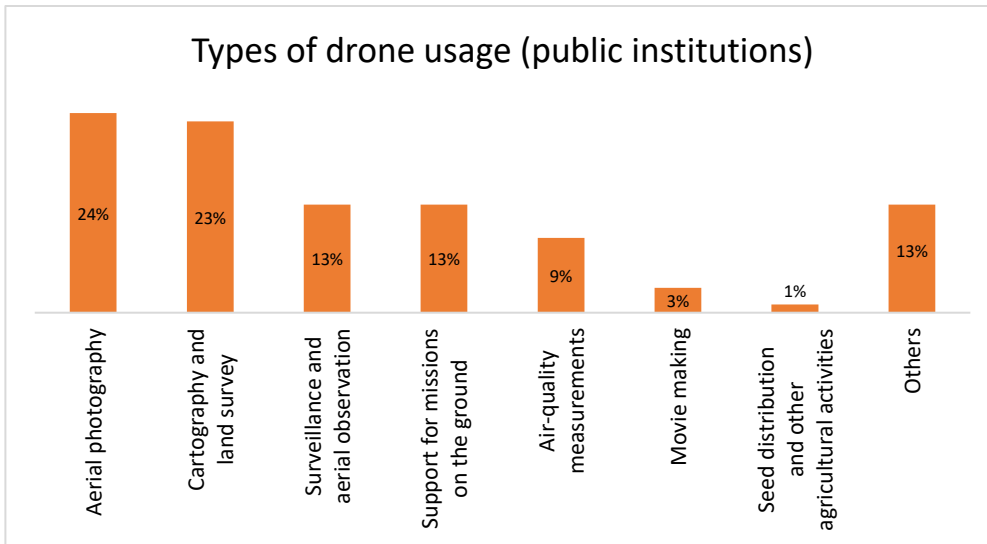
Figure 10.2: Types of drone usage (public institutions), N=128

g) *Spaces of drone usage* (Figures 11.1. & 11.2.): Drone usage takes place mostly in rural and in peripheral urban areas. High-risk sites and gatherings of people are rarely overflown (83% and 78% of the private drone users say they never overfly these two types of spaces, compared to 77% and 67% of the public drone users). In comparison, protected eco-zones and areas close to aerodromes are overflown more often (61% and 38% of private users indicate that they never overfly these types of spaces, compared to 44% and 33% of the public users). In general, public drone users are more likely than private drone users to overfly spaces of increased risk.
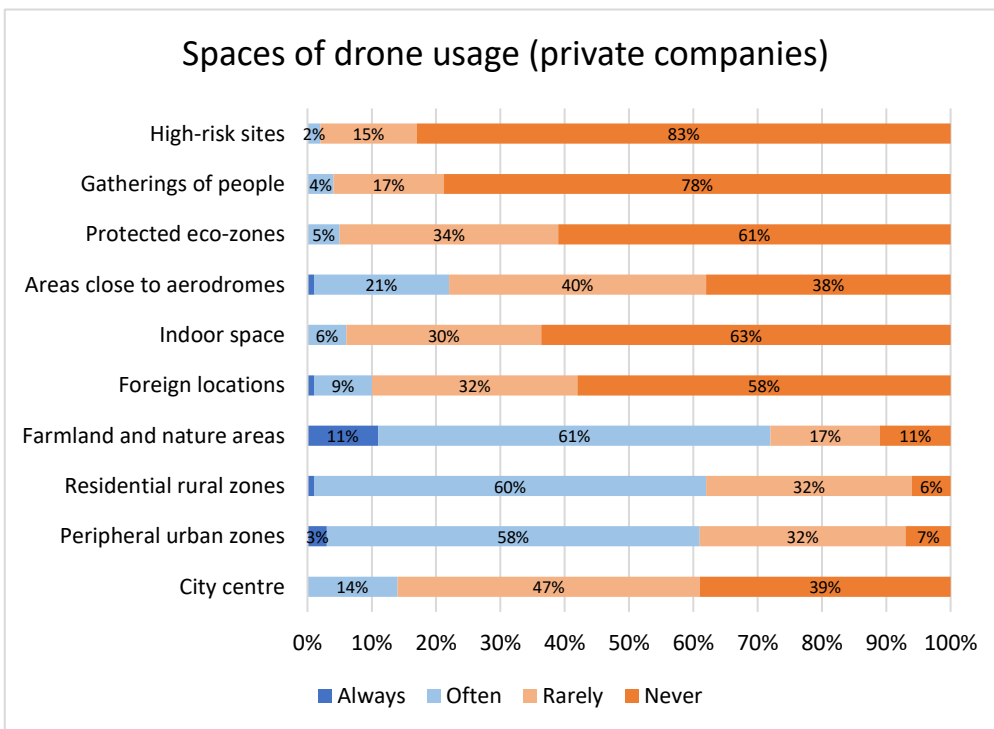
Figure 11.1: Spaces of drone usage (private companies), N=258

Spaces of drone usage (public institutions)

Category	Always	Often	Rarely	Never
High-risk sites			23%	77%
Gatherings of people		2%	31%	67%
Protected eco-zones		7%	48%	44%
Areas close to aerodromes	3%	20%	43%	33%
Indoor space			19%	81%
Foreign locations		2%	9%	90%
Farmland and nature areas	9%	37%	42%	12%
Residential rural zones	7%	36%	48%	9%
Peripheral urban zones	5%	41%	46%	8%
City centre	2%	12%	53%	33%
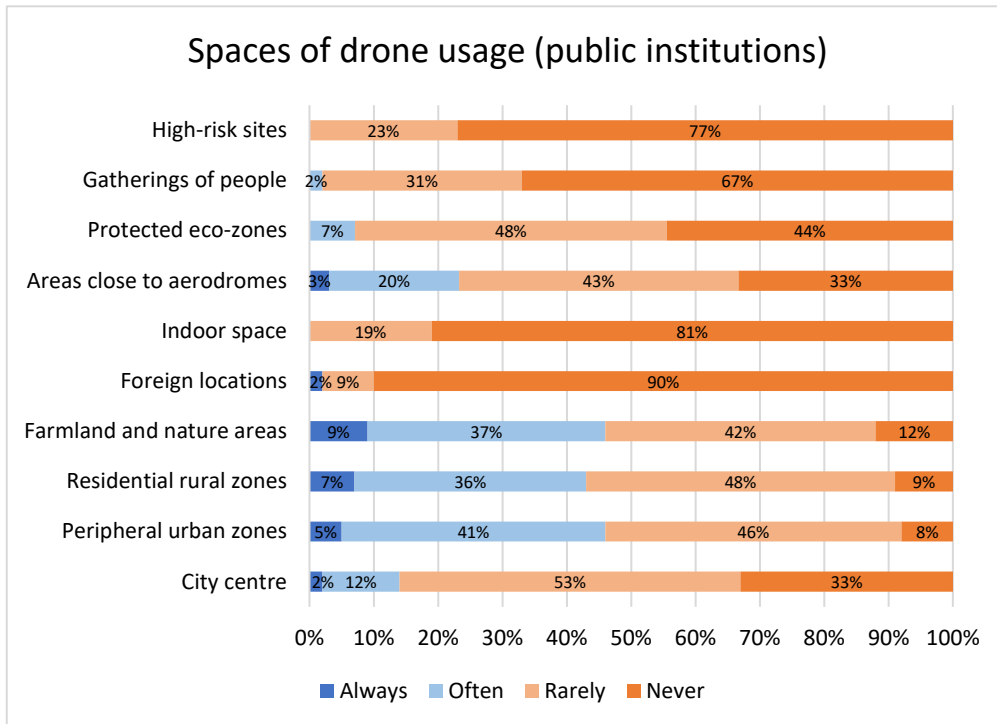
Figure 11.2: Spaces of drone usage (public institutions), N=60

h) Flight altitude (Figure 12): To a large extent, drone usage remains below the 300-metre limit, above which authorization is required (89% of the private drone users say they always fly below 300 metres, compared to 86% of the public drone users. Still, 11% and 14% of private and public drone users respectively indicate that they do fly above 300 metres.

Flight altitude

Altitude	Private companies	Public institutions
Up to 50 m	9%	19%
Between 51-100 m	19%	22%
Between 101-150 m	37%	31%
Between 151-300 m	24%	14%
Between 301-600 m	10%	7%
Beyond 600 m	1%	7%

Figure 12: Flight altitude, N=254, 58

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3.2. Motors and obstacles, opportunities and risks of professional drone usage

This section sheds light on a variety of factors that accelerate and/or limit professional drone usage. The following six key points deserve special elaboration:

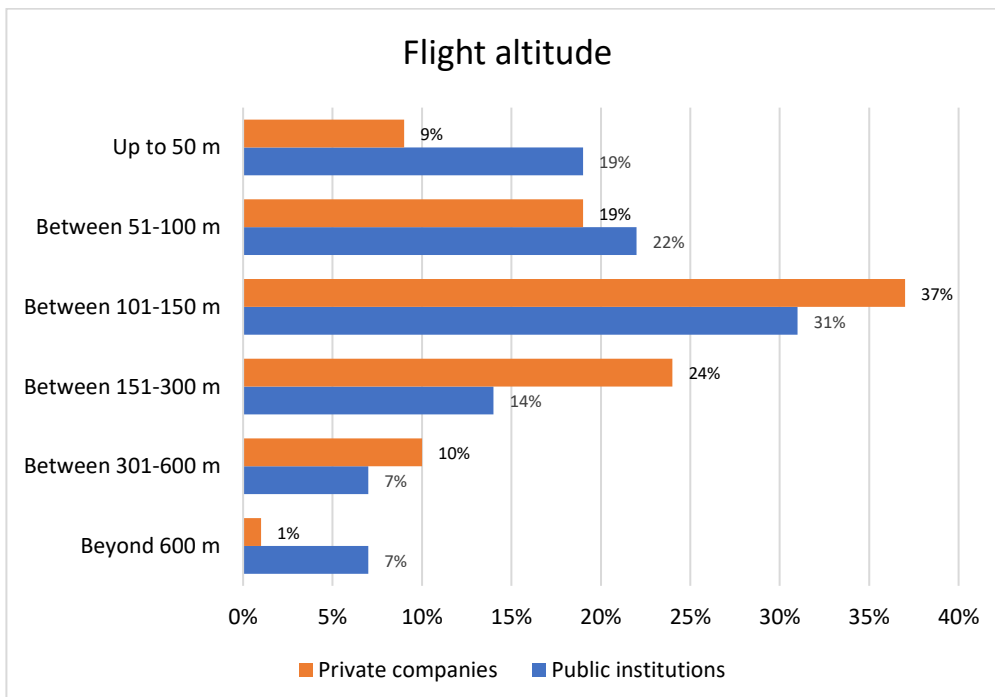a) *Airspace* (Figure 13): The majority of the survey participants – 79% and 63% of private and public drone users respectively – indicate that they would not use the airspace if they had no drone. It is the technology that makes them discover the "third dimension".
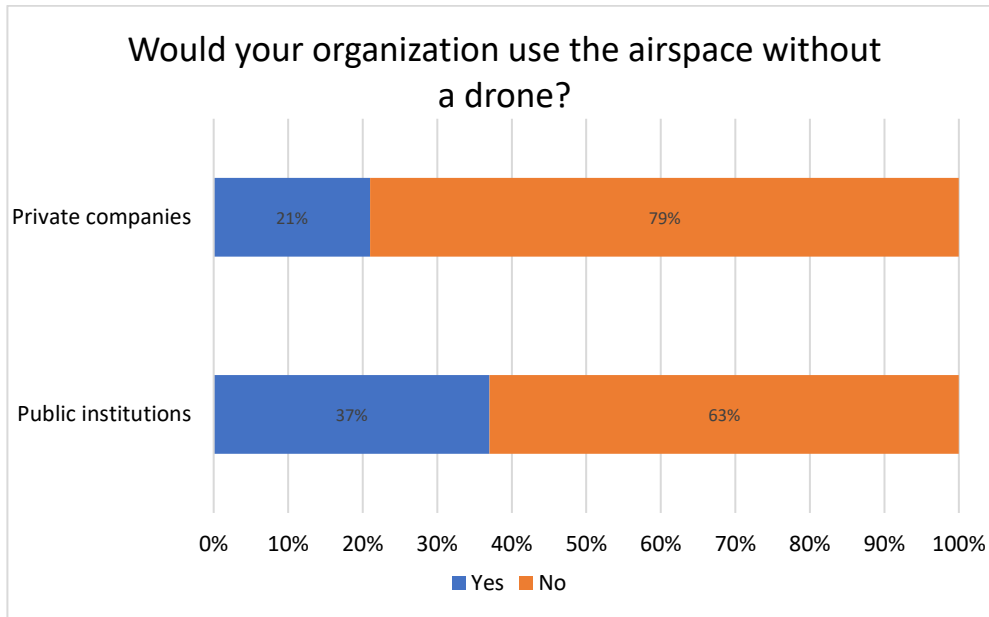
Figure 13: Would your organization use the airspace without a drone? N=253, 59

b) *Perpetuation of drone usage* (Figure 14): According to 75% and 83% of the private and public drone users, the technology has become indispensable for their organization ("agree" and "somewhat agree"). This hints at the technology perpetuating itself, once discovered as a working tool.
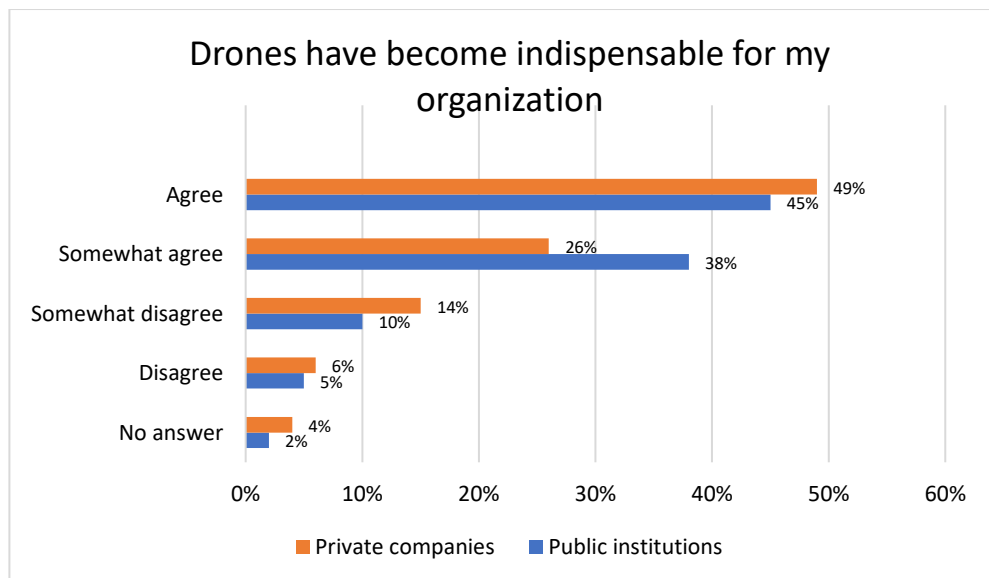

Figure 14: Drones have become indispensable for my organization, N=242, 58

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c) Benefits of drone usage (Figures 15.1 & 15.2): 75% of both the private and public drone users "agree" or "somewhat agree" that drones help their organization to save money. Furthermore, drones are seen to make existing services safer. 48% of the private drone users and 58% of the public drone users "agree" or "somewhat agree" with this conclusion. Yet above all, drones are perceived to help develop novel services, with 95% of the private drone users and 84% of the public drone users "agreeing" or "somewhat agreeing" with this.

Drones enable my company to...

	Agree	Somewhat agree	Somewhat disagree	Disagree	No answer
...save money	55%	20%	10%	6%	9%
...develop novel services	87%	8%			3%
...decrease the risks for employees	26%	22%	13%	25%	14%
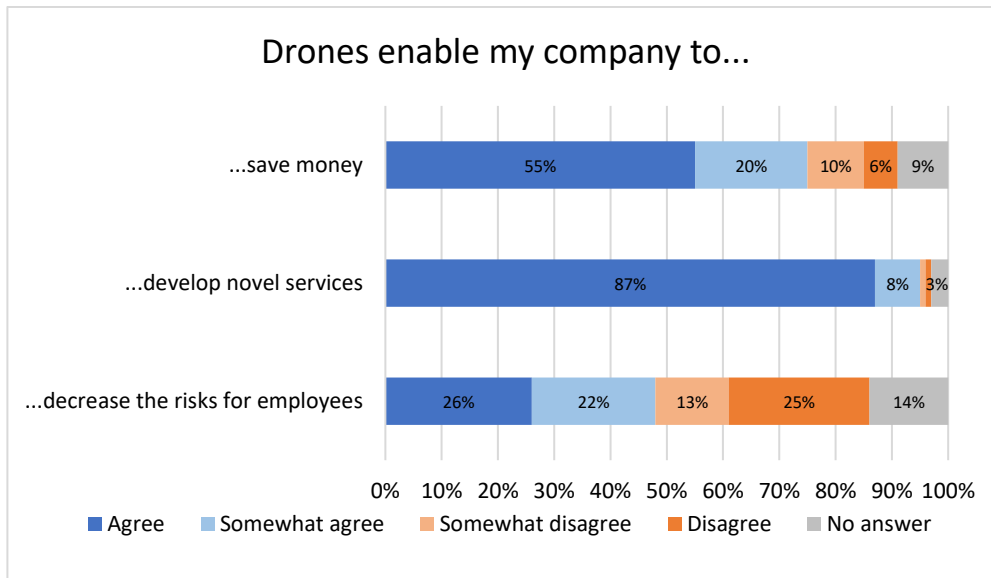
Figure 15.1: Advantages of drone usage (private companies), N=243

Drones enable my institution to…

	Agree	Somewhat agree	Somewhat disagree	Disagree	No answer
...save money	47%	28%	7%	5%	14%
...develop novel services	48%	36%	7%	5%	3%
...decrease the risks for employees	29%	29%	14%	17%	10%
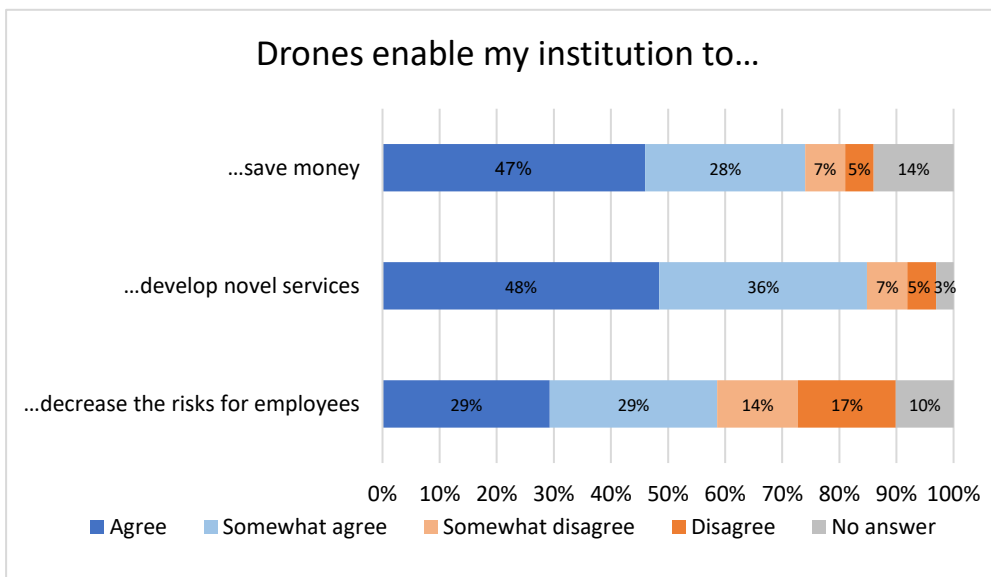
Figure 15.2: Advantages of drone usage (public institutions), N=58

d) Revenue (Figure 16): Private drone users were also asked in the survey to estimate the approximate drone-related revenue of their company. 36% estimate this to reach up to 10,000 CHF/year, whilst another 31% speak of up to 100,000 CHF/year. In contrast, only 4% believe the drone-related revenue to exceed 100,000 CHF. Thus whilst drones are perceived to be economically beneficial, this relates to relatively small revenues.

Figure 16: Estimation of drone-related revenue, N=239

e) *Risks* (Figures 17.1. & 17.2.): The most important risks regarding the usage of drones are perceived to be weather conditions (mentioned as high or medium risk by 49% of the private drone users and 67% of the public drone users) and human f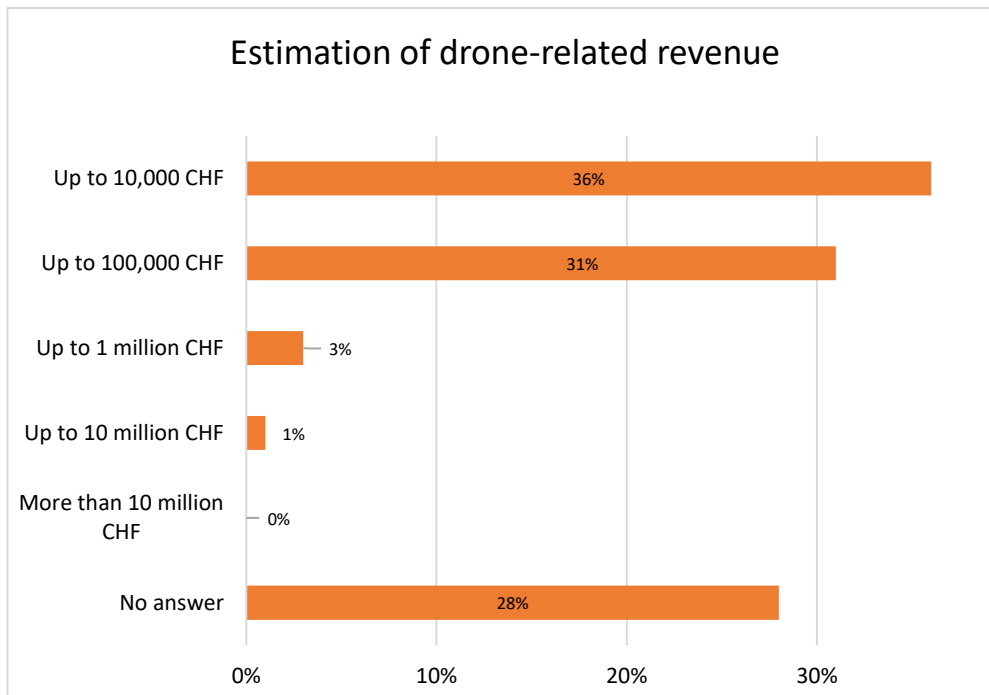actors (high or medium risk for 49% of the private drone users and 40% of the public drone users). In contrast, the risk of collisions was perceived to be very low (mentioned as high or medium risk by only 12% of both the private and public drone users). Drones are perceived to be relatively safe professional tools in good weather conditions and with good piloting.

Risks related to	High	Medium	Low	None	No answer
Damage to equipment	10%	38%	51%	2%	0%
Defects in material and/or manufacturing	2%	29%	66%	3%	0%
Weather conditions	12%	37%	46%	4%	0%
Collisions	1%	11%	71%	17%	0%
Human factors	12%	37%	46%	5%	0%

Figure 17.1: Risk perception by private drone users, N=242

Risks related to	High	Medium	Low	None	No answer
Damage to equipment	29%	41%	29%	0%	0%
Defects in material and/or manufacturing	3%	31%	62%	2%	2%
Weather conditions	24%	43%	29%	3%	0%
Collisions	3%	9%	71%	16%	2%
Human factors	12%	28%	57%	2%	2%

Figure 17.2: Risk perception by public drone users, N=58

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f) *Limitations of drone usage* (Figures 18.1 &18.2): Asked to select from a list of twelve pre-given options the three most important factors that limit professional drone usage, two key aspects stand out: weather conditions (selected by 74% of the private drone users and 72% of the public drone users) and the legal framework (selected by 66% and 55% respectively). This underscores the importance of the next section of the paper (see below), relating to perceptions of the legal framework around drones. It is also worth considering the high percentage of private users (54%) who think that a low acceptance rate by the population limits drone operation, whilst public drone users are more convinced of the population's support (32% selected a lack of social acceptability as a limiting factor).
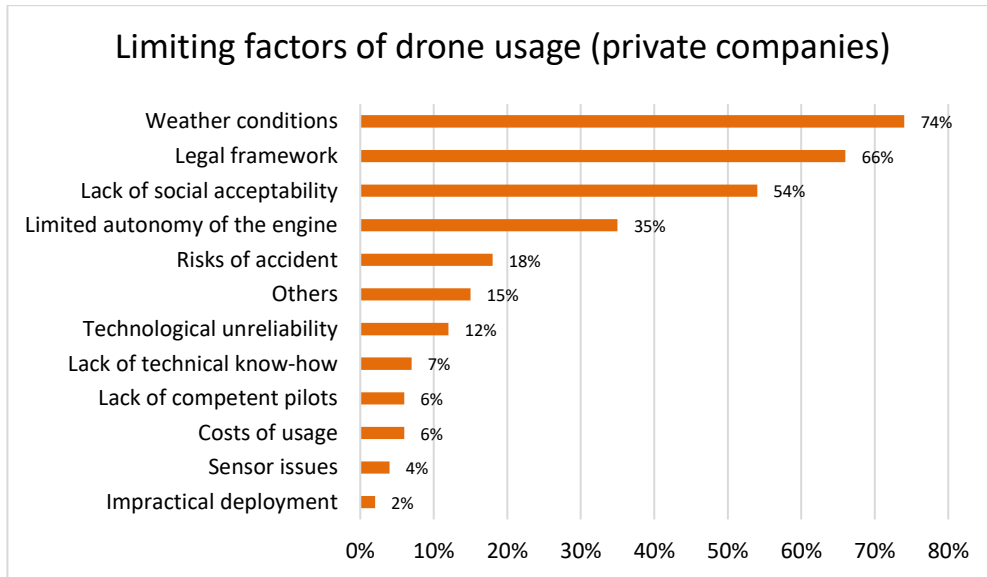

Figure 18.1: Limiting factors of private drone usage (three selections possible from predefined list), N=228
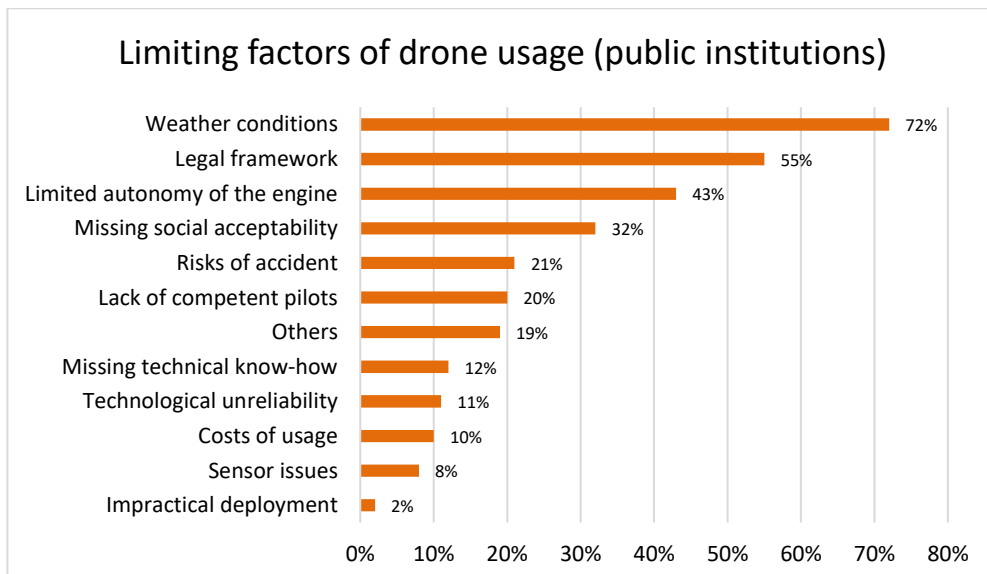

Figure 18.2: Limiting factors of public drone usage (three selections possible from predefined list), N=54

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3.3. Drone legislation

As shown, drones have become increasingly important as professional tools. This raises a series of critical questions regarding the legal regulation of drone usage. In this section, we present key insights with regard to how professional drone users perceive the Swiss drone legislation.

a) *Required authorization* (Figure 19): 90% of the private and 79% of the public drone users say that they do not require special authorization from the Swiss Federal Office of Civil Aviation (FOCA) or Skyguide. Regarding private drone usage in particular, this number is higher than what could be expected from Figures 11.1, 11.2 and 12.
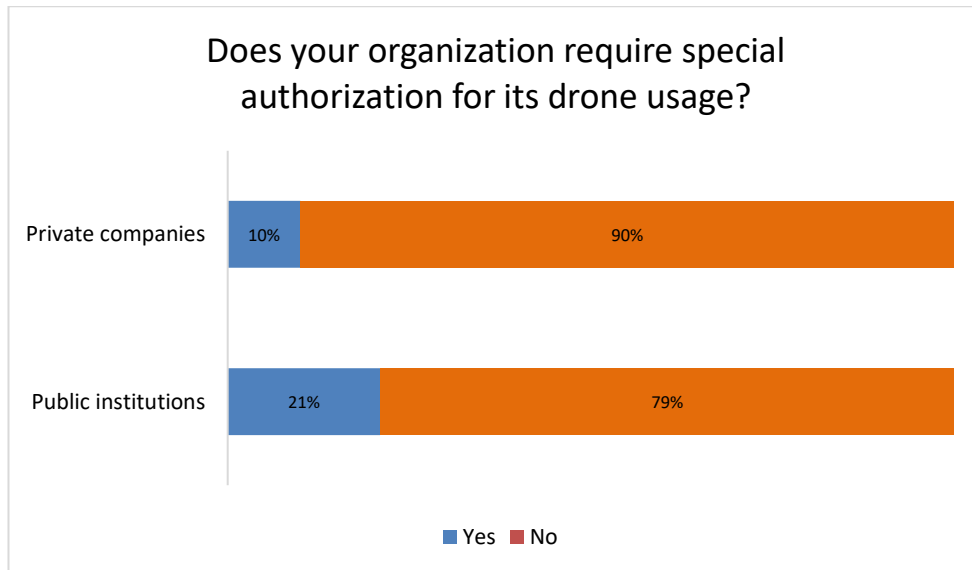
Figure 19: Does your organization require special authorization for its drone usage? N=242, 58

b) *Adequacy of current legislation* (Figures 20.1 & 20.2): 71% of the private drone users and 65% of the public drone users consider the legal framework to be "adequate" or "rather adequate" to prevent accidents. 78% (private companies) and 63% (public institutions) think likewise with respect to the issue of privacy protection. In the case of terrorism, the image is less positive (28% and 34% think that the legal framework is "inadequate" or "rather inadequate", with 23% and 30% of "no answers"). More generally speaking, it appears that public institutions are somewhat more critical of the legal framework's adequacy than private companies.

16
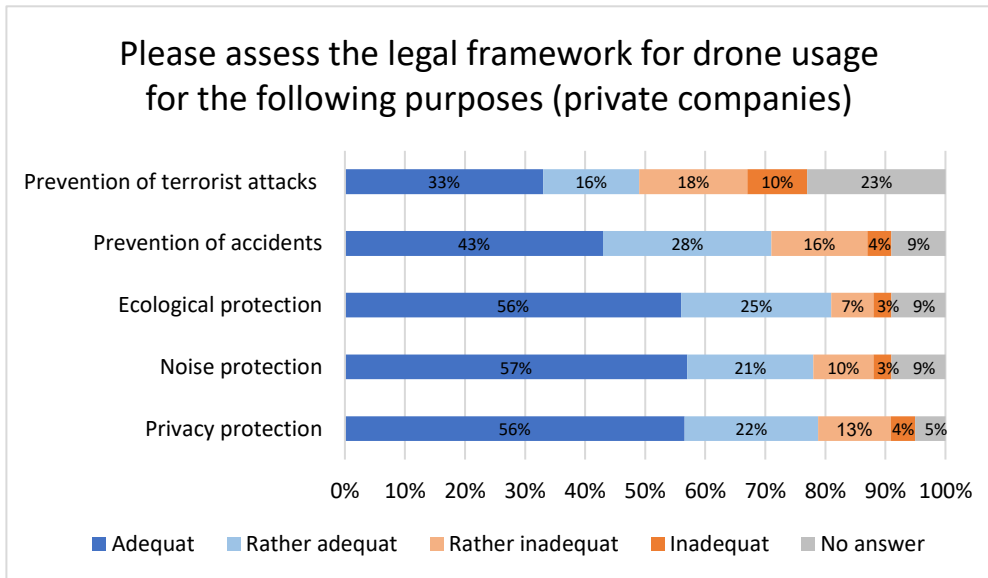
Figure 20.1: Assessment by private companies of the legal framework for drone usage, N=240
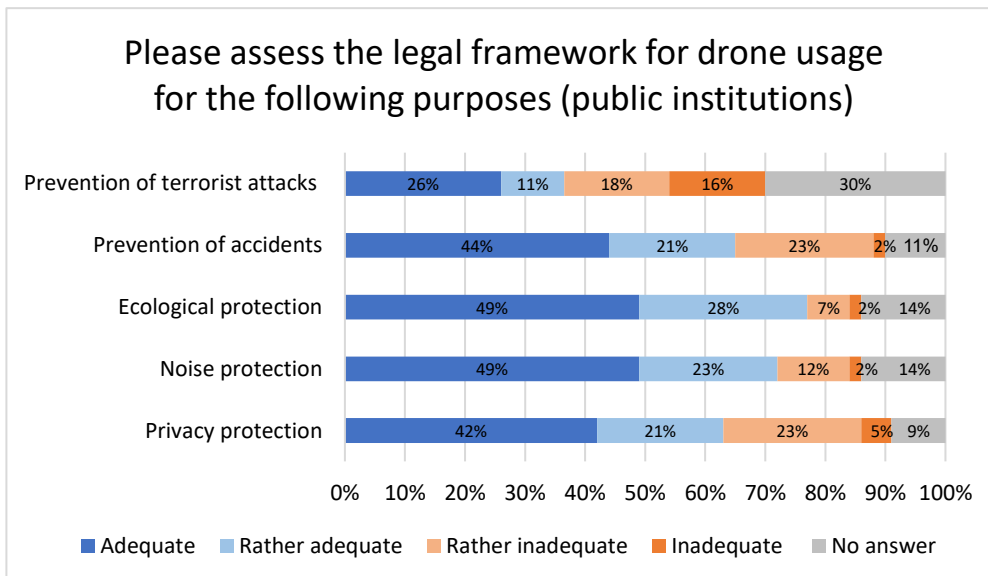
Figure 20.2: Assessment by public institutions of the legal framework for drone usage, N=57

c) *Acceptance of current legislation* (Figures 21.1 & 21.2): Public and private drone users largely approve of the basic conditions for drone usage imposed by the existing legislation. This is particularly evident with regard to the interdiction of approaching high-risk sites (85% and 90% of approval amongst private and public drone users) and gatherings of people (76% and 77% of approval), with the requirement of a liability insurance of one million CHF (95% and 95% of approval) and with the obligation to respect privacy-protection legislation (92% and 91% of approval). In contrast, the requirement of special authorization to fly outside of the visual line of sight is met somewhat more sceptically, especially by private companies (34% of the private drone users disapprove of this obligation, compared to 23% of the public sector).

Assessment of the requirements for the operation of drones (private companies)

Prohibition of drone usage above high-risk sites — Agree 57% | Somewhat agree 28% | Somewhat disagree 12% | Disagree 2%

Prohibition of drone usage within 100 meters from gatherings of people — Agree 47% | Somewhat agree 29% | Somewhat disagree 18% | Disagree 5%
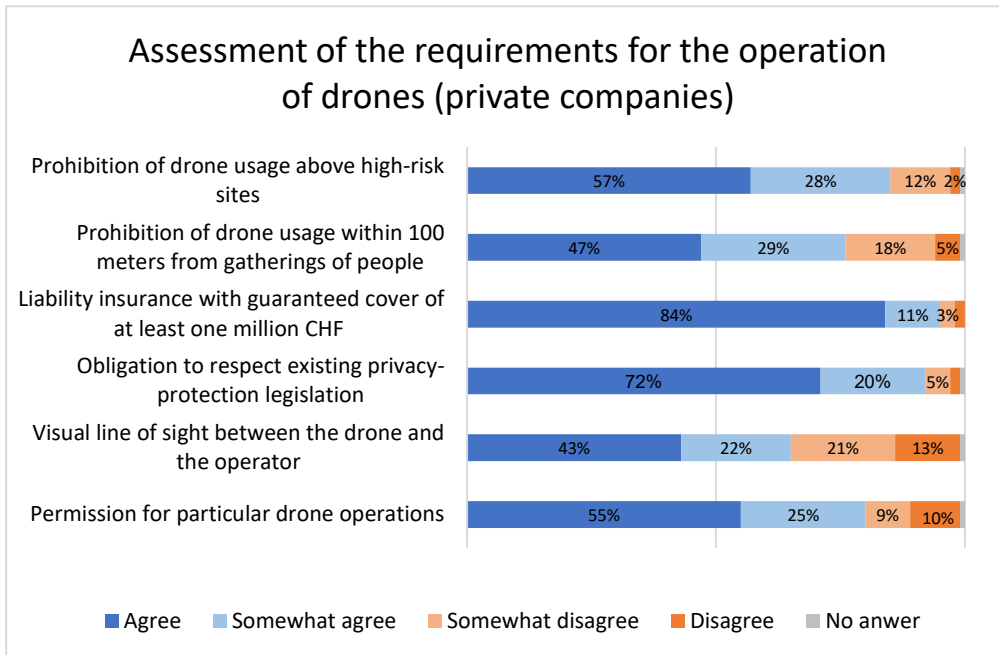
Liability insurance with guaranteed cover of at least one million CHF — Agree 84% | Somewhat agree 11% | Somewhat disagree 3%

Obligation to respect existing privacy-protection legislation — Agree 72% | Somewhat agree 20% | Somewhat disagree 5%

Visual line of sight between the drone and the operator — Agree 43% | Somewhat agree 22% | Somewhat disagree 21% | Disagree 13%

Permission for particular drone operations — Agree 55% | Somewhat agree 25% | Somewhat disagree 9% | Disagree 10%

■ Agree ■ Somewhat agree ■ Somewhat disagree ■ Disagree ■ No anwer

Figure 21.1: Assessment of the requirements for the operation of drones (private companies), N=239

Assessment of the requirements for the operation of drones (public institutions)

Prohibition of drone usage above high-risk sites — Agree 74% | Somewhat agree 16% | Somewhat disagree 5% | Disagree 4%

Prohibition of drone usage within 100 meters from gatherings of people — Agree 58% | Somewhat agree 19% | Somewhat disagree 16% | Disagree 7%

Liability insurance with guaranteed cover of at least one million CHF — Agree 79% | Somewhat agree 16% | Somewhat disagree 4%

Obligation to respect existing privacy-protection legislation — Agree 72% | Somewhat agree 19% | Somewhat disagree 7%

Visual line of sight between the drone and the operator — Agree 53% | Somewhat agree 23% | Somewhat disagree 14% | Disagree 9%

Permission for particular drone operations — Agree 68% | Somewhat agree 23% | Somewhat disagree 5% | Disagree 2%

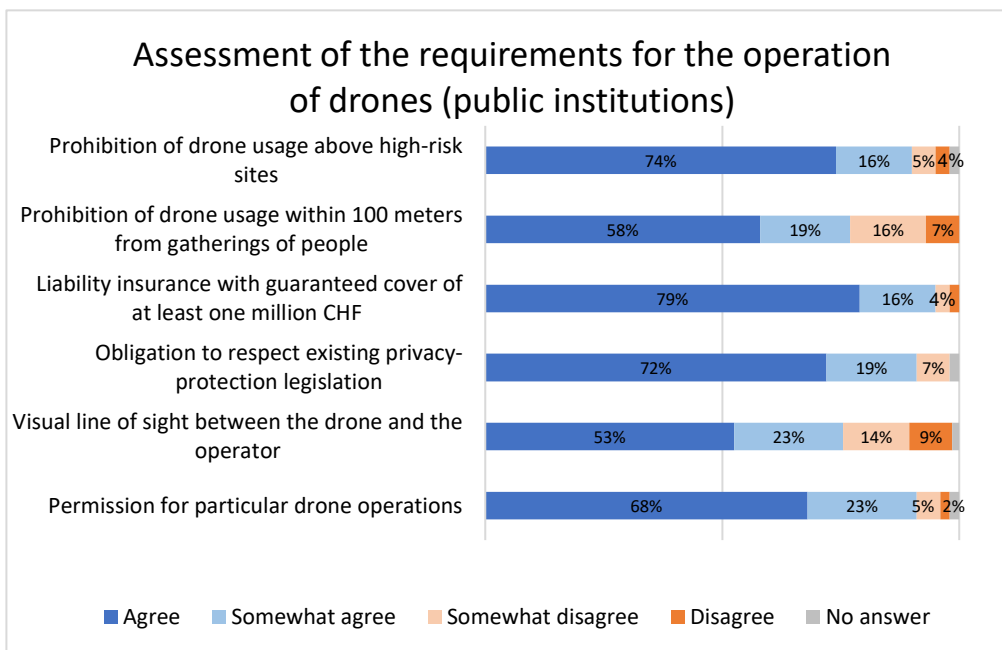■ Agree ■ Somewhat agree ■ Somewhat disagree ■ Disagree ■ No answer

Figure 21.2: Assessment by public institutions of the requirements for the operation of drones (public institutions), N=57

3.4. Future scenarios of professional drone usage

This section moves beyond questions regarding the present, to anticipate the future of professional drone usage in Switzerland. There are five main aspects worth summarizing.

a) *Permission of professional drone usage* (Figure 22): 53% of the private drone users "agree" that all professional drone usage should be allowed (compared to a 39% agreement amongst public drone users). This can be read as a (mostly private) request to facilitate the future evolution of professional drone usage in Switzerland.
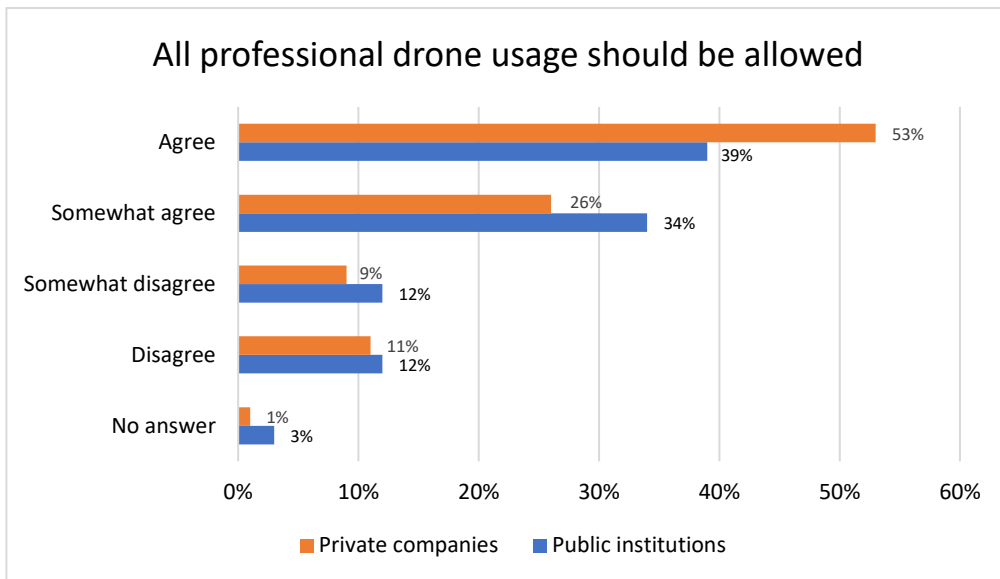
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Figure 22: All professional drone usage should be allowed, N=253, 59

b) *Potential usefulness in the future* (Figure 23): Amongst those survey participants who neither own a drone, nor have thought explicitly about acquiring one, 55% of the private participants and 60% of the public participants think that drones could be potentially useful for their organization, thus hinting at the likeliness of a continued evolution of the phenomenon in the future.
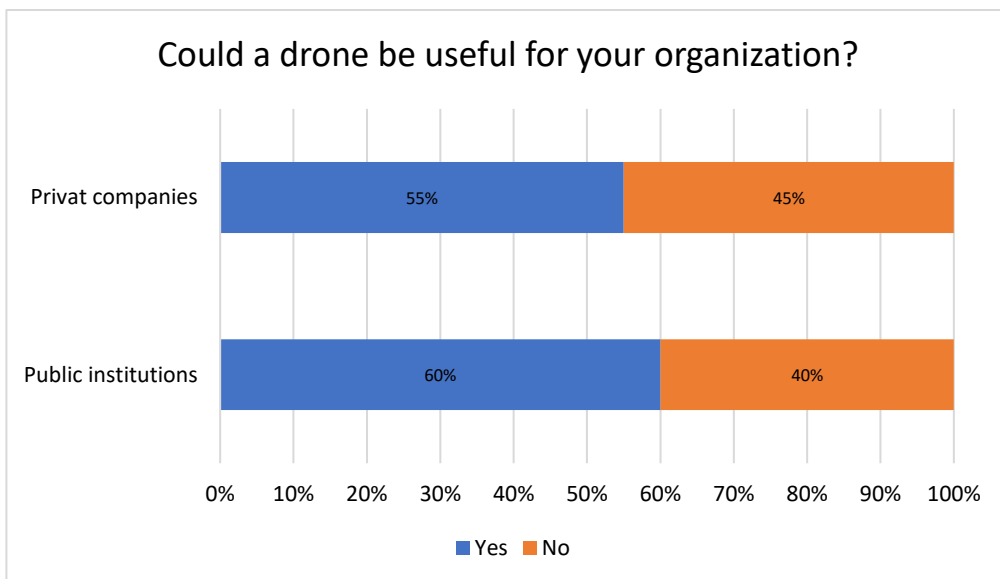

Figure 23: Could a drone be useful for your organization?, N=214, 66

c) *Expected evolution of drone usage* (Figures 24.1 & 24.2): 90% of the private drone users and 98% of the public drone users expect their deployment of drones to be more frequent in the future ("agree" or "somewhat agree"). In addition, 91% of both the private and public drone users expect their drone to be replaced by a more sophisticated model. This underlines that users of the technology are also committed to further extending and improving their usage of drones. More generally speaking, 78% of the private drone users and 86% of the public drone users "agree" or "somewhat agree" that peer companies/institutions will also start using drones. Thus

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those who already work with drones paint a future scenario in which professional drone usage in their field will further increase.
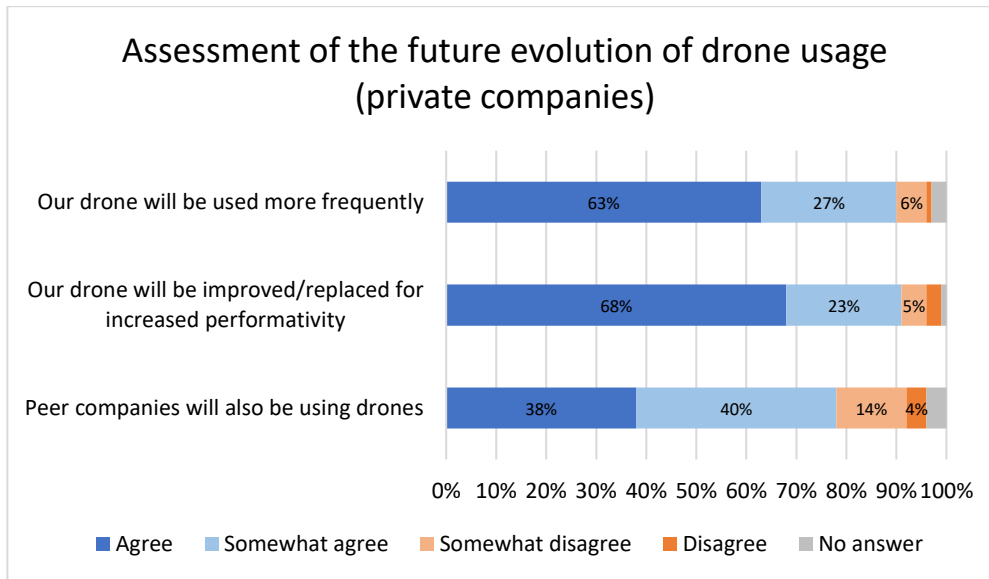
Assessment of the future evolution of drone usage (private companies)

Figure 24.1: Assessment of the future evolution of drone usage (private companies), N=239

Assessment of the future evolution of drone usage (public institutions)
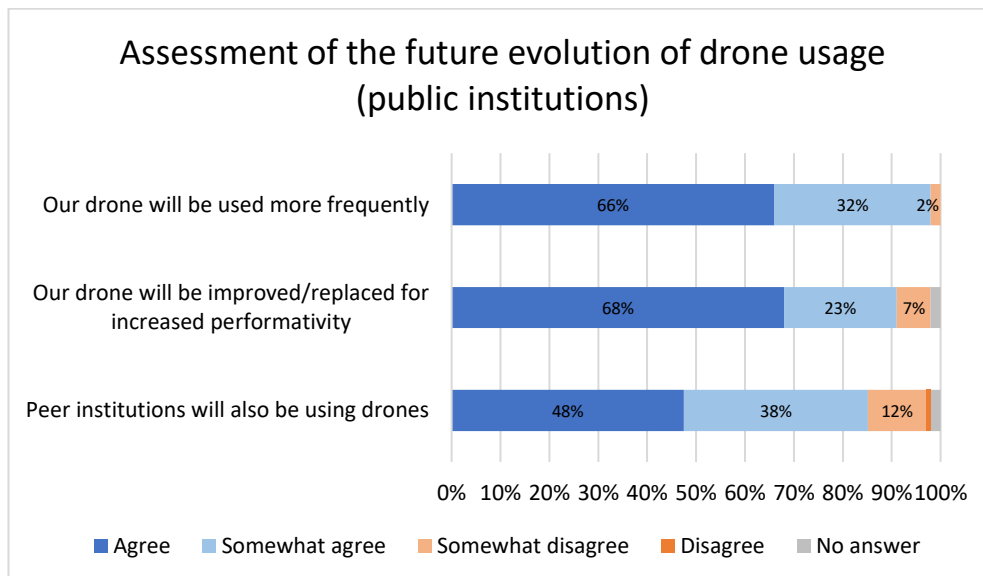

Figure 24.2: Assessment of the future evolution of drone usage (public institutions), N=56

d) *Public-private collaborations* (Figure 25): 90% of the private drone users and 79% of the public users "agree" or "somewhat agree" that there are likely to be increased public-private collaborations around professional drone usage in the future. Thus the technology is expected to bring the two sectors closer together.
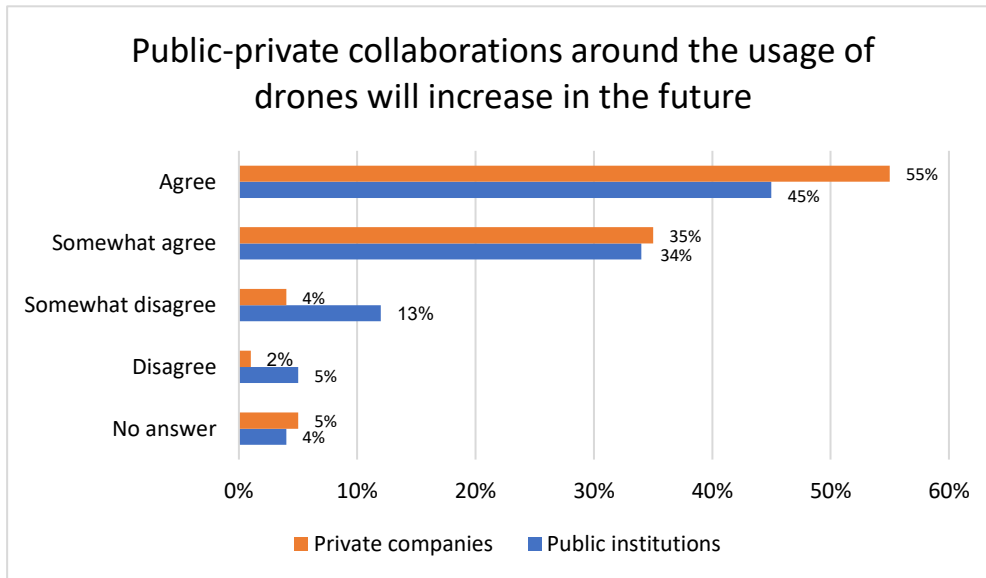
Figure 25: Public-private collaborations around the usage of drones will increase in the future, N=239, 56

e) *Drone numbers* (Figure 26): Both the private and public survey participants hold a broadly shared belief that drones will increase in numbers over the next ten years. It is most relevant here to highlight the expressed expectations in relative terms, comparing the future to the current situation. 57% of the respondents expect the number of drones to multiply two- to ten-fold over the next ten years, and 24% predict that there will be 10 to 20 times more drones in ten years' time. Again, this reiterates the broadly shared belief that the technology will proliferate further in the future.
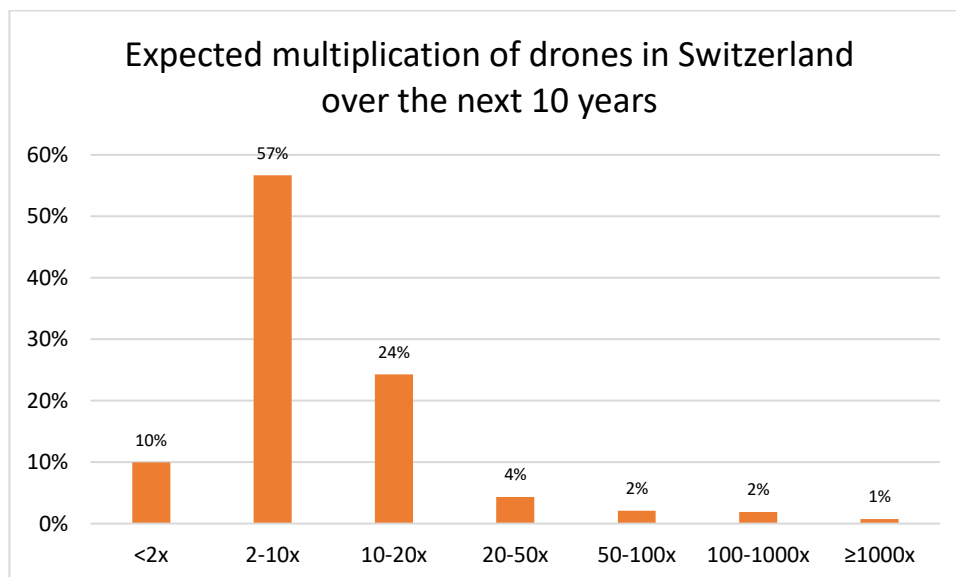

Figure 26: Expected multiplication of drones in Switzerland over the next 10 years, N=448

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4. Conclusion

This paper offers the first systematic study of professional drone usage in Switzerland. More specifically, the discussed survey data (1) affords much needed empirical insight into the driving forces that are behind current drone developments, (2) shows how and where drones are used professionally in Switzerland, (3) highlights the perceived benefits, risks and limitations of current drone usage, (4) outlines how private and public drone users assess the existing legal framework, and (5) underscores the expected future evolutions in the field.

Regarding private drone usage, in particular, our study reveals the recent emergence of a highly dynamic branch of economic activity (79% of drone users would not use the airspace without drones), in which drones are often used weekly (38% of private drone users) or at least monthly (another 35%). For 87% of the private drone users, the technology allows the development of novel economic activities, which generate revenues of 10'000 CHF (36%) to 100'000 CHF (31%). Key purposes hereby are aerial photography and filming.

A majority of private drone users approve of the legal regulations in the field, although some requirements are seen more critically than others. For example, 34% disagree with the "visual-line-of-sight" obligation, whereas privacy protection is largely accepted, with only 4% of disagreement. 79% ask for any type of professional drone usage to be allowed. Survey participants see huge potential in the market, not only with regard to the future number of drones (57% expect the number of drones to multiply between two and ten-fold over the next ten years), but also in more qualitative, technological terms (91% expect to use more advanced technology in the future).

In the public sector, drone usage is more sporadic, but relies on more sophisticated, software-driven technology (50% use image analysis software). Drones are thereby deployed more often above high-risk zones and other areas of increased risk, such as gatherings of people. Thus public drones more often require special authorization (21% of drone users say they have special authorizations). In the public sector too, we see huge potential for drone usage to develop further. 60% of those public institutions who don't have a drone and have not yet thought about buying one think that the technology could be useful. 85% of public drone users think that peer institutions will also use drones in the future, and 91% of public drone users expect to use more advanced technology in the future.

Taken together, these insights underline the potential of professional drone usage, but also raise a series of major questions with regard to future evolutions in the field. Key issues include social acceptability (18% of private drone users see social acceptability as a limiting factor) and risks (for example, 48% of the private drone users and 70% of the public drone users think that "damages to the equipment" might cause high or medium risks). Further questions range from the legal challenges regarding the elaboration and enforcement of novel regulations for the controlled integration of drones in the Swiss airspace, to the novel forms of collaboration and interdependencies around professional drone usage (79% of public drone users "agree" or "somewhat agree" that public private collaborations around the usage of drones will increase in the future).

Importantly, our analysis of the survey results is as yet not complete. For example, a large number of graphs and information regarding those participants who do not yet use drones, but who have already thought about doing so (43% of the private companies and 23% of the public institutions who have participated in the survey) are still to be explored, with a view to providing a more solid understanding of how drones will be used in the future. It will also be necessary to study in more detail the usage of drones by specific professional categories, and to position the results of the present survey within a wider research agenda that also involves the perception of drone usage by the population and the deepened investigation of specific case studies of how drones are used by particular institutions. These additional approaches are also part of the research agenda on 'Power and Space in the Drone Age' pursued at Neuchâtel University and will be brought together systematically in the future.

5. References

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