Stiftung für Technologiefolgen-Abschätzung
Fondation pour l'évaluation des choix technologiques
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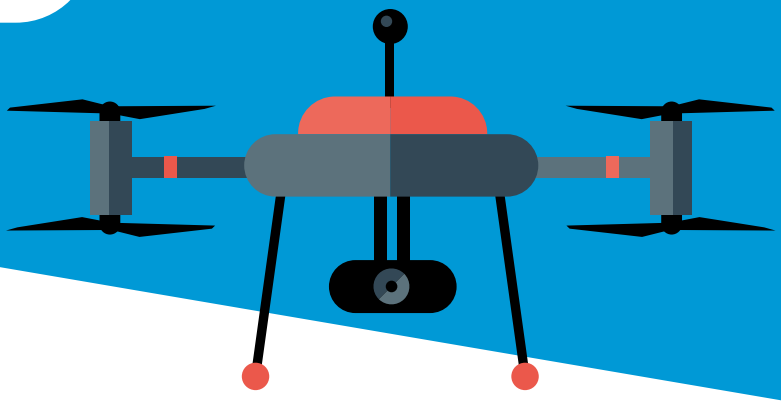
Foundation for Technology Assessment

Remote-controlled flying machines

Abridged version of the study «Zivile Drohnen – Herausforderungen und Perspektiven»



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TA-SWISS, Foundation for Technology Assessment and a centre for excellence of the Swiss Academies of Arts and Sciences, deals with the opportunities and risks of new technologies.

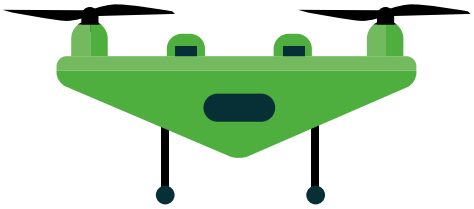
This abridged version is based on a scientific study carried out on behalf of TA-SWISS by an interdisciplinary project team led by Dr. Michel Guillaume, Centre for Aviation, Zurich University of Applied Sciences (ZHAW). The abridged version presents the most important results and conclusions of the study in condensed form and is aimed at a broad audience.

Zivile Drohnen – Herausforderungen und Perspektiven

Markus Christen, Michel Guillaume, Maximilian Jablonowski, Peter Lenhart und Kurt Moll
TA-SWISS, Stiftung für Technologiefolgen-Abschätzung (Ed.)
Vdf Hochschulverlag an der ETH Zürich, 2018
ISBN 978-3-7281-3893-4

Also available in open access: www.vdf.ethz.ch

This abridged version can be downloaded at no cost: www.ta-swiss.ch



The study in brief

Drones are already a reality in today's airspace. Although some people are critical of these aircraft – they have a nefarious reputation as instruments of war but they put civil aviation at risk and disturb the tranquillity and intimacy of the place of residence – drones are also one of the most popular Christmas presents around. Their commercial uses and applications are more and more diverse. With sensors that give them a high degree of autonomy, drones are controlled by pilots and can access hard-to-reach areas beyond the pilot's normal line of sight. As their numbers grow rapidly, many questions remain about their current and future capabilities, as well as the risks that they could pose in some areas. The interdisciplinary analysis commissioned by TA-SWISS provides a clearer understanding of these issues and tries to highlight possible policy measures which could be taken.

Opportunities

Drones are a real opportunity for the Swiss economy. With multiple applications, they can be deployed in many sectors: logistics, agriculture, surveillance, research, surveying and measurement, media and leisure, humanitarian aid, etc. Although it is very much early days in terms of their development in a commercial setting, it seems clear that drones will in some instances replace more traditional solutions.

Risks

There are also several challenges facing drones. Some people perceive them as spies when they fly over towns and residential areas: with their cameras, they can see where human eyes cannot. Outside of towns and cities, they are seen as disruptive to nature and wildlife in particular. The noise of their motors or propellers and their presence in protected areas can be particularly disturbing. But the experts agree that the principle challenge is a technical one: above all else, drones must not crash. Even if there are problems, drones of a certain size must be able to land safely.

Recommendations

This foresight study was produced by an interdisciplinary group led by Zurich University of Applied Sciences (ZHAW) and examines the issues and outlook for civil drones. It provides an overview of the current situation and reflects on the next steps in the development of the technology. Based on these reflections, the project group has set out the following recommendations in order of priority.

1. The regulatory framework needs to be more transparent: the legal basis for evaluating the technical safety of civil drones and the issuing of permits needs to be revisited. The concept of a drone also needs to be defined, with different regulations for drones and for model aircraft.

2. A U-space (management system for unmanned air traffic) must be put into place to promote research and dialogue with a view to developing an air traffic management system for autonomous aircraft. The following aspects must be studied carefully: systems to avoid collisions to guarantee the safety of other airspace users; the possibility of flying beyond the visual line of sight of the pilot (BVLOS flight) in order to realise the full economic potential of drones; and measures to enforce bans on overflying protected areas.

3. Changes to the regulations must be able to guarantee the implementation of protection measures. A national civil drone registration and identification system must be put into place; guidelines on pilot training must be formulated; the manufacturers and distributors of drones must be obliged to provide clear information on the applicable law when a drone is purchased, especially with regard to respecting privacy and protecting the environment.

4. Switzerland must make the most of the international context. It must make an active contribution to ongoing discussions but not necessarily follow all European regulations to the letter: interests must be weighed up to ensure Swiss stakeholders in the field are not neglected.

5. A dialogue on the U-Space must be initiated and organised by the Federal Civil Aviation Office.

6. Questions on areas to be protected need to be discussed among the stakeholders affected under the supervision of the Federal Environment Office.

7. The state should promote and finance a national test area that would also be supported by the industry.

Introduction

Just a few years ago, the birds shared the skies above our heads with aeroplanes, of course, helicopters and other hobby aircraft such as gliders, paragliders, parachutes, kites and model airplanes. But our airspace is set to get even busier, a trend which is already noticeable. Drones will reach every level of airspace, from the highest (above 20,000 metres) for activities relating to telecommunications to the lowest (below 150 metres) for activities such as crop dusting.

This study was initially commissioned by TA-SWISS in January 2016 to answer the question: are drones a technology of the future? During the course of the study, it has become clear that the question no longer needs to be asked: drones are here to stay. Whether for leisure use, like the best-selling Christmas presents, or as part of commercial activities such as transport of small objects or infrastructure surveillance, civil drones are everywhere. In Switzerland, 22,000 are sold every year, with 100,000 in the skies already. It is such a success story that, in December 2017, the Federal Civil Aviation Authority announced that it was no longer able to respond personally to users other than the authorities and emergency services.

From the point of view of the authorities, this massive influx poses several questions in terms of regulation, with flight authorisation requests currently handled as exceptions on a case-by-case basis. Given the increasing number of drones in circulation, this puts a strain of legal equality. But suitable regulations, especially with respect to technical safety, can only be developed once the concept of a drone has been defined, and this concept simply does not currently exist in Swiss law.

The areas of application of this technology are manifold and are likely to develop substantially in the years to come as drone technology advances. This will result in various challenges, both in terms of privacy and environmental protection.

As part of this foresight study, a panel of experts made up of regular drone users, researchers, businesses and environmental advocates were consulted to gain a better understanding of the issues and outlook for the technology.

Everyone’s talking about drones

Drones have been trending for some years now. They are the subject of more and more articles both in scientific literature and in the media. An analysis of various databases shows a clear increase in articles on this subject since the beginning of the decade.

In the general international media, until today attention is primarily focussed on military drones. Indeed, when analysing articles by geography, it becomes apparent that the Middle East and Asia regions are more often covered, especially given that they have been – or still are – theatres for wars in which the use of drones has received widespread media coverage. The spotlight is on military and intelligence use.

On the other hand, scientific literature largely covers the civil use of drones. So it is not surprising that drones are becoming increasingly present in both our professional and private lives.

In Switzerland

The trends are similar across the Swiss media: between 2012 and 2016, more than 5600 articles on military and civil drones were published in the leading German and French-language newspapers. While at the beginning of this period the proportion dedicated to military applications was nearly 80%, this has fallen substantially and now only represents one fifth across the board. So civil drones are gaining in popularity. It is also interesting to note the difference in slant between the country’s linguistic regions. Overall, the subject is covered more positively in French-speaking Switzerland than in German-speaking Switzerland, where there is much more frequent mention of the dangers and the risks. This is certainly due to the presence of a “Drone Valley” near Lausanne, where many start-ups, including spin-offs from EPFL, are active in the sector.

An object hard to define

At first glance, defining what constitutes a drone does not seem a particularly difficult task. But these new airspace users are still seeking their place within the current legal framework, where the formalisation of a definition which suits the majority of them is a real challenge for legislators. The existing proposals in the different regulations concerned at both a Swiss and an international level are evidence of just how difficult the task is. The very notion of a drone, such as it exists, is covered in two different ways: some highlight the autonomy of the machines while others stress their ability to be controlled remotely.

In the current Swiss legislation, the term ‘drone’ is never used. In its absence, these pilotless aircraft are considered as a subset of model aeroplanes. The International Civil Aviation Organisation (ICAO) puts them on an equal footing by defining two categories at the same level, one for drones and one for model aeroplanes. The difference lies in the fact that the former can be flown beyond the line of sight of the pilot.

Nobody is happy with the current proposals, but the authors of the study acknowledge that it is very difficult to make a conceptual distinction between model aeroplanes and drones from a technical standpoint. Effective regulations can, however, still be proposed based on type of use, which will reduce the pressure for a strict definition. Nevertheless, the current legal predominance of model aircraft is inadequate because drones are by no means miniature aeroplanes. The new Swiss approach aims to put model aeroplanes and drones on an equal footing defined under a common designation of pilotless aircraft, and this seems more promising. Whatever the outcome, it would force the introduction of the concept of a drone into the legal framework, even if an exact technical distinction cannot be given.

Characteristics of drones beyond the formal definition

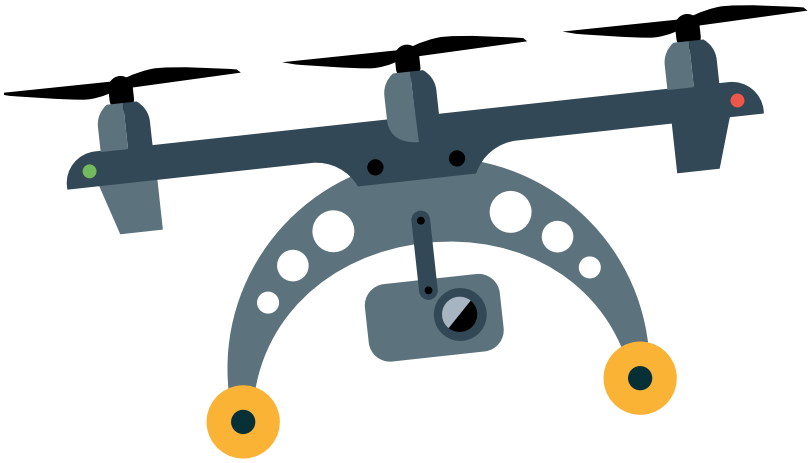
Drones weigh somewhere between a few hundred grams and a ton. If they are less than 30 kilograms, no flight permit is required, as long as the drone is flying in the pilot's field of vision : pilots must comply with several rules issued by the Federal Civil Aviation Office, including never allowing the aircraft out of sight. Above this weight limit, pilots must apply for authorisation to fly. These applications are handled on a case-by-case basis according to an internal procedure. Flights beyond the visual line of sight always require an authorisation.

All applications for a licence, which are the responsibility of the FOCA, are subject to the so-called SORA process (Specific Operations Risk Assessment), a risk analysis for the use of unmanned flight systems.

They fly close or far

For everyone, a drone is a device which is controlled remotely and fitted with various recorders and sensors which allow both the pilot to navigate his device and the unit to collect and record data. Some drones can also use these sensors to travel completely autonomously (without direction from a pilot). This autonomy is permitted in Switzerland, providing the pilot is able to retake control of the aircraft at any time.

There are two flight modes for a drone: it remains visible to the pilot or it travels such that it is no longer visible (either because of distance or because of obstacles impairing visibility). In the jargon, these



two types of flight are called VLOS (Visual Line of Sight) and BVLOS (Beyond Visual Line of Sight). The main advantage of drone technology lies in BVLOS flight, which enables innovative applications and uses to fully realise their economic potential. Given their small size, the requirement to maintain visual contact restricts the range of the drone and the benefit in using a drone is reduced.

Drones can be classified into two broad categories according to their use: they are either recording systems or transport systems.

Recording systems

The first type of drone allows information to be gathered in areas which are normally difficult to access using cameras, microphones or other built-in sensors. They can be used for surveillance purposes: to observe people or, in a different context, to detect young wild animals and keep them safe before crops are harvested. They can also be used for surveillance of sensitive buildings, such as nuclear power stations, or other large-scale infrastructures such as the road system or electricity network. Drones are important tools for accessing hard-to-reach areas and their outstanding mobility and speed mean they can work over long distances.

Transport systems

The transport system category includes both drones which can transport substances or equipment to areas which are difficult to access and those which can travel very quickly and efficiently from A to B to transport objects for logistical purposes. Although it is just a pipe dream at this stage, the development of a network of autonomous aerial taxis would add large-scale drones to this category. Finally, drones can also be used as relay stations for carrying information when normal communication networks are down.

Photographer or taxi: the skills of a drone

These two types of drone, depending on the flight mode employed, can be used in various areas and for very different purposes, as is already the case today. Forecasts suggest that, by 2025, they will be indispensable and very widespread, with various technical advances along the way. The following areas are organised alphabetically.

Agriculture

Some farmers are already convinced about the advantages of drones for helping in their everyday work and improving the yield of their crops. These aircraft can be used for spreading phytosanitary products and fertilisers. At the same time, it is already possible to study the health and condition of a field or a forest using special cameras. In future, using drones instead of helicopters, for example, would be a benefit in environmental terms.

Authorities

From the authorities' perspective, there are great hopes for more systematic use of drones for various tasks, such as searching for missing persons, border control, reconnaissance after natural disasters or accidents in hard-to-reach areas. They can also be used to detect harmful substances in the air after a chemical or nuclear accident. The police and emergency services currently own few drones, but they are set to become more widespread: this is likely to raise various questions in the medium term relating to privacy, questions which the authorities and especially the police already face today. The authorities will also have to think about how to tackle the illegal use of drones and ways of intercepting them.

Construction

In construction, drones are already very useful for aerial viewing, which allows work progress to be monitored and any problems to be highlighted quicker. By 2025, drones will not only help construction companies in planning, but also in monitoring work sites and marketing of finished projects.

Humanitarian

In crisis situations, such as humanitarian operations following natural disasters, drones could prove extremely useful in reaching areas which have become inaccessible or dangerous. This could allow the transport of medication or the equipment necessary to repair a communication network, but there is currently no centralised coordination which would allow the deployment of these drones. This is a problem which will increasingly need to be addressed in the years to come.

Media and advertising

Drones are already regularly used in media and entertainment, primarily to film scenes from different angles while containing costs. There are numerous companies specialising in this area in Switzerland, working with the tourist offices, among others. Over the next decade, this large number will probably become smaller, leaving a few providers offering high-performance services thanks to very large fleets.

Measurement and surveillance

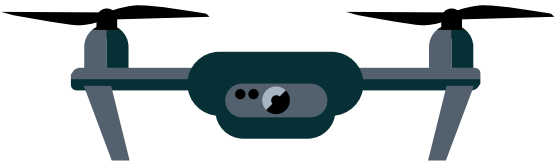
All commercial measurement and surveillance activities might be affected by drones in the next few years. The arrival on the market of new types of sensors and the fact that drones can handle increasingly large volumes of data will make them indispensable tools when it comes to inspecting infrastructures and monitoring wildlife, for example.

Research

Researchers will also benefit from using drones in their work. They will be able to collect and process data from the air without disproportionate costs. Whether this is in the field of archaeology, marine biology or climate research, the data will be much easier to collect and will be of great help for scientific research.

Transport

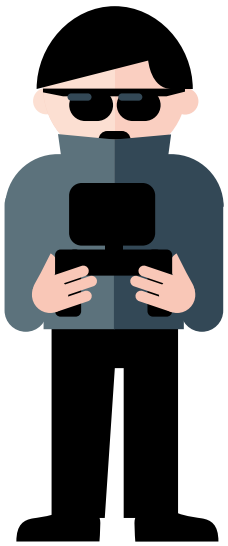
There is also great hope for the second kind of drone, those for transporting goods or people. While some trials have already been carried out with a certain level of success, such as the transport of blood samples between two hospitals in Tessin, it will take a few more years before this becomes an everyday reality. What's more, it appears that many of the potential applications would not be economically viable. As for the transport of people, there are still too many safety issues for this to become a reasonable proposition within the next few years. Of the experts interviewed for the study, there are few that would dare climb aboard an autonomous drone to get around, whereas they would happily do so on a land-based vehicle, such as autonomous trains or trams.



Criminal activity

Of course, there is a whole host of criminal uses: drones are sometimes used to deliberately invade people's privacy, to carry contraband such as small quantities of drugs, for spying around sensitive infrastructures or for terrorist activities. There are currently no genuinely effective means of combating these illegal drones: on the one hand, electromagnetic pulses could be used to take control of a drone or disable it completely, on the other, alternative physical systems could provide a defence against them. These could include nets, lasers, missiles or even specially trained birds. These defence mechanisms are under-developed today but will need to be deployed as quickly as drones themselves.

Various studies suggest that it will be activities related to agriculture, infrastructure monitoring and surveillance by the authorities which will see the most rapid expansion in the future. However, none of these developments will be possible without a massive increase in BVLOS flight.



Legislative challenges

The Federal Civil Aviation Authority is in charge of questions relating to drones. Anyone wishing to fly a small drone (up to 30 kilograms) must comply with the regulations available on the office's website. For drones beyond this limit as well as flights without visual contact, users must submit an application to the office, which will grant a flight permit where applicable. Permits are issued on a case-by-case basis in accordance with an internal procedure. Given the prevalence of these aircraft these days, this is surprising and even problematic. It is difficult to ensure equal treatment for all those needing permits, which runs counter to the principle of legality that is enshrined in Swiss law.

So this legal framework needs to be adapted: the legal basis for evaluating the safety systems of civil drones needs to be updated to simplify the issuing of flight permits and avoid case-by-case processing. This adaptation means introducing the concept of a drone into the regulations. The Federal Civil Aviation Authority has already embarked on the important process of revising the applicable regulations.

The drone issue is intrinsically linked to the places they are used and the objectives of their pilots. Indeed, drones can be deployed in public or private places which are owned by the pilot or a third party. A distinction also needs to be made between different fields of application: these include pure entertainment, observation with sound or images recorded, commercial or government activities. The whole spectrum of illegal uses also needs to be taken into consideration. This means that several laws will have to be taken into consideration, such as regulations on protection of privacy, data, property, the environment, protected areas, and use of the public domain. According to the authors of the study, Swiss law in most areas is perfectly adequate to form a framework for the commissioning and use of civil drones in the country.

If a drone is used in an inappropriate or illegal way, the main difficulty lies in identifying the pilot who committed the offence. The legal framework define the offences, but the absence of a national register of drones and of any obligation to install an identification technical device means that the offenders are rarely be intercepted, so there is no opportunity for the law to be applied.

It is for this reason that the authors of the study have formulated a clear recommendation that a mechanism for identifying drones should be put in place. An electronic system would use a transmitter to produce a continuous signal which would allow the drone to be identified at all times. When buying a new drone, the owner would be legally obliged to register it. This measure would also give a clear overview of the economic potential of this technology. The Federal Civil Aviation Authority is already working on the implementation of a system of this kind as part of the revision of the current regulations.

In addition to a register of drones, there must be a series of clear instructions on pilot training, such as those issued at a European level by the European Aviation Safety Agency (EASA). At the same time, the manufacturers and distributors of drones must be obliged to clearly inform future users, when they buy these devices, about the regulations in force, primarily in terms of environmental protection and data protection.

In this context, Switzerland needs to become an active partner in the international discussions on drones and regulations relating to them. However, all the European regulations should not simply be adopted as they are. The pros and cons need to be weighed up clearly and the best options available applied in the interests of the stakeholders in Switzerland.

When drones pose a problem

The experts interviewed for the purposes of the study found that the general public has a somewhat negative view of drones. This perception is certainly because they were initially used for military purposes. However, civil drones are becoming increasingly present in our everyday lives and their image is developing more positively. But some experts believe that further media coverage of their use in conflict situations could tarnish their reputation again. But if we set aside this image as a weapon of war remotely piloted far away from conflict zones, the public's concerns about drones largely relate to invasion of privacy and, to a lesser extent, to the disruption they could cause to nature and wildlife in particular. The experts have observed these concerns among the public but point out that the first challenge for the introduction of these aircraft on a large scale lies in the technology's safety.

The technical challenges

So, although the public does not see things from this perspective, the major challenge is technological: drones must be able to fly and, if necessary, land quickly and completely safely. Any problem with the battery or the programming of the drone which could result in it crashing could have catastrophic consequences, especially with larger drones. Further advances in this technology are therefore needed to guarantee safe autonomous flight and thus continue its development in the civil sector.

Landing is a critical element: the drone must be capable of landing completely autonomously without causing damage to its surroundings, when the communication with the pilot is lost. The technology must also allow detection of other airspace users, so they can share the air without incident.

For the development of drones, the experts believe that technological improvements in terms of autonomy, more efficient GPS and warning systems or the development of more powerful batteries and lighter materials will be of particular importance.

Respecting privacy

Although the experts downplay its significance, the aspect that concerns the public most is the respect of privacy. Drones are most commonly perceived as spies. This is partly due to the military origins of the aircraft. These days, we know that, in all probability, a drone flying over a residential area has a camera which is recording images. There is also some interest among law enforcement agencies in using drones for surveillance purposes. Many citizens fear a police state.

Whatever the case, it is very likely that those being inconvenienced do not know who is controlling the device. This intrusion of privacy is the source of some tension, as drones are able to fly to places that were previously thought inaccessible, easily reaching the top floors of apartment blocks and flying over the gates and hedges which form the boundaries of private gardens. As we know, Swiss citizens are rightly protected by the various regulations, but the anonymity of the pilot makes it impossible to enforce the law. In the event of a dispute, to whom do you turn? How do you get rid of an intrusive drone if you do not know who is controlling it?

Protection of the environment

From an environmental perspective, drones pose two major problems: the first is related to the noise emitted during flight, the second is the fear and disturbance they can cause to wild animals in particular.

Noise is generated by the blades on the propellers of multicopter-type drones but also depends on the wind and the direct environment. A study carried out by NASA demonstrated that the noise emitted by drones is considered particularly annoying, partly because the people surveyed were not used to it (as they would be to car noise, for example). There have been few other studies on the subject and, as a result, the problem is now considered anecdotal. But if the growth in the number of drones in the airspace would increase, the problem would need to be addressed at some point.

There are currently no studies into the effects of drones on wildlife. However, it can be imagined that regular fly-overs cause stress reactions among wild animals. The same applies for flights with very random movements, as can be the case for leisure activities. The animals most affected are birds. By studying cases where a clear, recognisable response is observed (fight or flight), it becomes clear that large groups of animals detect the presence of a drone in a range of 100 to 700 metres (compared to 100 to 450 metres for smaller groups). That said, more research in this area is needed to determine the long-term negative effects of the presence of drones in the airspace, especially on the stress felt by birds. The results of an American study suggest that drones do not necessarily provoke flight responses, but the stress felt is real and evidenced by an increase in heart rate.

The wildlife conservation organisations, especially those focussing on birds, which formed part of the group accompanying the study, were adamant about the problems that these devices pose and about the need for consideration, although these environmental issues are not considered a priority by the experts surveyed.

Today in Switzerland, drones are not allowed to fly in Federal game reserves that are nature conservation areas or in national and international water bird and migratory bird protection areas.

There needs to be a global consideration of which areas are to be protected. To be easy for pilots to comply with them, the rules must not be disparate between the different Swiss districts and cantons. This dialogue between the different partners must be coordinated by the Federal Office for the Environment. Environmental protection issues will be taken into consideration, but clearly the process must also be extended to questions of privacy, which could also result in a list of areas where drones are banned from flying.

A U-space for traffic coordination

On top of all the technical, social and environmental challenges, the increasing numbers of drones must be able to share the airspace with the other stakeholders already using it: aeroplanes, helicopters, gliders and other hobby flyers (paragliders, parachutists, etc.). Collisions could have extremely serious consequences for the people involved or even for third parties who are simply in the wrong place at the wrong time. In this context, it is important to remember that some drones are already capable of BVLOS flight, meaning the pilot no longer has visual contact with the aircraft he is controlling and is therefore not able to evaluate the risks from the immediate surroundings of the drone. It is also worth noting that given the small size of most drones, it is not reasonable to expect that the pilot of an aeroplane, for example, would be able to identify a drone in time to avoid it.

This means drones need to be fitted with “detect and avoid” systems which can provide a technical answer to the principle of “see and be seen”. In conventional aviation, this principle is based on having a pilot on board who is able to see other airspace users. The collision detection systems to be implemented therefore need to replace the pilot’s vision, be capable of recognising other aircraft in time and, if necessary, take evasive action or land. Such systems do not currently exist, but are under development. In addition, there are still no approval regulations.

The Swiss air traffic management system for piloted flights is operated by Skyguide. The implementation of a similar system for the management of unpiloted (or remotely piloted) air traffic is critically important for the development of drone technology. The Lausanne-based non-governmental organisation Global UTM Association is dedicated to this task. A system for the management of unpiloted air traffic is called UTM (unmanned traffic management) in the United States or U-space in Europe. This provides a range of functions to make air traffic safe. Various elements are critical for the implementation of a system of this kind. The drones themselves and all flying devices without pilots form an integral part. In parallel, the U-space must be linked to a register which lists all active drones and a system to iden-

tify their positions in real time. Topographical and meteorological data also play an important role, as does the information exchanged with traditional air traffic control systems. Finally, the U-space can also play a role in investigating incidents or accidents by sharing information and receiving and implementing recommendations aimed at drone users.

A technological solution still needs to be developed, possibly based on the current mobile communications network, as does all the infrastructure which would support the U-space. In the end, the challenge lies in integrating this system with the standard air traffic management system or at least linking them to allow coordination of all air users.

In September 2017, Skyguide held a live demonstration in Geneva with three drones to show what such a U-space could look like.

In this context, research and dialogue between the stakeholders affected must be encouraged to put a Swiss U-space into place. This means supporting for research into collision prevention, removing the legal obstacles currently preventing BVLOS flight and implementing clear measures to prevent the overflying of protected zones.

What technologies will be on board tomorrow's drones?

Technological advances in artificial intelligence, energy management (batteries) and collision detection will play a role in the further development of drones.

The automation of procedures in aerial navigation can be a complex problem because it has a direct impact on the safety and reliability of flights. To make certain functions autonomous, the data collected by the numerous sensors fitted to drones must be processed without error to avoid accidents. At the same time, systems need redundancy built in to compensate for failures or other faults.

Artificial intelligence systems are still only very rarely fitted to current drones. It is also difficult to imagine that drones which can make their own decisions based on data recorded in flight will be buzzing around above our heads by 2025, although some researchers are more alarmist than the authors of this study.

The question of battery life will determine the duration of flights and the distance that drones can travel, as well as the loads they can carry. Transport of people, for example, could only be carried out on condition that the batteries built into the aircraft were of sufficient quality. So they play a key role in the future development of the technology.

Finally, as we have already seen, "detect and avoid" technology is also critical for BVLOS flight which, if it develops, has massive economic potential in terms of new uses and applications.

There is currently no test site where researchers can evaluate the equipment they develop to resolve all these technical questions. A clearly defined space dedicated to testing this technology could address all the questions posed by creating a U-space, as well as the technical challenges.

Conclusion: very much a current technology

During the study, around sixty experts were approached and interviewed on what future they saw for drone technology. These experts were drawn from every area concerned: the authorities, airspace stakeholders, fundamental research, manufacturers and users, animal and nature protection organisations, data protection experts, etc. The group also contained experts who considered themselves enthusiastic, neutral or critical with respect to the technology.

They believe that, in 10 years' time, drones will be present in various regions of the country and their acceptance by the public and more widespread use will depend on areas of application: while the public is likely to have few reservations about seeing drones used for agricultural purposes instead of helicopters, large-scale use of drones in towns for taking pictures or surveillance would definitely be seen as more problematic. Usage in residential areas must be regulated as it touches on questions of privacy, an issue of particular public concern and, as such, an important challenge to face. Outside of residential areas, in particular towns, the experts also share a similar view: use needs to be regulated, the primary objective being to define protected areas, especially for preserving nature and wildlife.

In this respect, it is important to initiate dialogue at a national level with all the stakeholders concerned on the zones to be protected so that standardised rules can be applied and communicated.

These risks notwithstanding, there are also opportunities for the technology in Switzerland. The experts agree on the major potential of civil drones for the Swiss economy: promising areas include surveillance of infrastructures such as railways, and the extremely broad sector of aerial photography for the media, tourism and architecture. Logistics-related activities are considered less promising.

Drones need to improve their robustness and autonomy to capitalise on this economic development. Autonomous landing, safe communication and faultless recognition of other airspace users are aspects which urgently require improvement. Autonomy in particular holds real potential for Swiss industry. Finally, if these drones are to be part of the airspace, the experts believe that a U-space (UTM) is indispensable and that these technical challenges must be addressed quickly. A drone must be able to fly completely safely and be able to manage any faults which occur, even if its pilot cannot see or communicate with it. Research and industry still have much to do in this area, which is why it would be beneficial and highly desirable for a test area to be set up, financed by the state and with the support of the industry.

It would allow this technology, which is very much present already, to continue to develop successfully and realise its incredible potential while respecting the stakeholders affected, who must be consulted and considered during this period of rapid growth.

Study «Zivile Drohnen – Herausforderungen und Perspektiven»

Project team

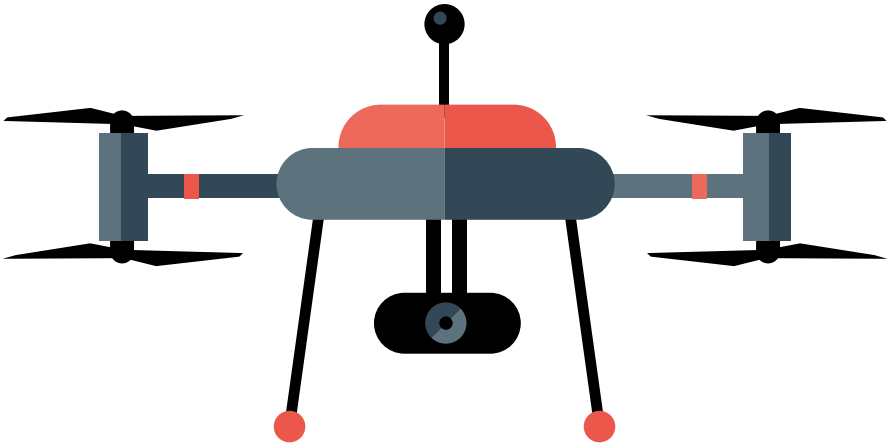
- Prof. Dr. Michel Guillaume, Leiter Zentrum für Aviatik, Zürcher Hochschule für Angewandte Wissenschaften (ZHAW)
- PD Dr. Markus Christen, Geschäftsleiter UZH Digital Society Initiative, Universität Zürich
- Dr. Kurt Moll, Rechtsanwalt, Bern
- Dr. Ing. Peter M. Lenhart, Zentrum für Aviatik, ZHAW
- Maximilian Jablonowski, M.A., Institut für Sozialanthropologie und Empirische Kulturwissenschaft, Universität Zürich

Supervisory group

- Dr. Bruno Baeriswyl, TA-SWISS Leitungsausschuss, Datenschutzbeauftragter des Kantons Zürich
- Dr. Felix Altorfer, Eidgenössisches Nuklearsicherheitsinspektorat ENSI (Vertreter der Kommission für Technologie und Innovation KTI)
- Bruno Arnold, AGRIDEA (Schweizerische Vereinigung für die Entwicklung der Landwirtschaft und des ländlichen Raums)
- Siddhartha Arora, IBM Switzerland
- Reto Büttner, Schweizer Verband Ziviler Drohnen (SVZD)
- Laurent Delétraz, skyguide - swiss air navigation services ltd
- Markus Farner, Bundesamt für Zivilluftfahrt (BAZL)
- Dr. Olivier Glassey, TA-SWISS Leitungsausschuss, Faculté des sciences sociales et politiques (SSP), Université de Lausanne
- Dr. Rolf Hügli, Schweizerische Akademie der Technischen Wissenschaften SATW
- Dr. Quentin Ladetto, armasuisse Wissenschaft und Technologie
- Arthur Leibundgut, Bundesamt für Kommunikation (BAKOM)
- Andrea Marrazzo, Schweizerische Post
- Yves Michel, Office fédéral de la Communication (OFCOM)
- Werner Müller, BirdLife Schweiz (Schweizer Vogelschutz SVS)
- Dr. Alice Reichmuth Pfammatter, Datenschutzexpertin und Rechtsanwältin

TA-SWISS project supervision

- Dr. Catherine Pugin, TA-SWISS



Impressum
Remote-controlled flying machines
Abridged version of the study «Zivile Drohnen – Herausforderungen und Perspektiven»
TA-SWISS, Bern 2018
TA 66A/2018

Author: Catherine Pugin, TA-SWISS, Bern
Translation: CLS Communication AG, Basel
Production: Christine D'Anna-Huber, TA-SWISS, Bern
Layout and graphics: Hannes Saxer, Bern
Printed by: Jordi AG – Das Medienhaus, Belp

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TA-SWISS
Foundation for Technology Assessment
Brunngasse 36
CH-3011 Bern
info@ta-swiss.ch
www.ta-swiss.ch

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